ATTACHMENT K

MONITORING AND MAINTENANCE PLAN

MONITORING AND MAINTENANCE PLAN
RIVERBANK SOURCE CONTROL MEASURE

EVRAZ Oregon Steel

Prepared for
EVRAZ Oregon Steel
14400 North Rivergate Blvd.
Portland, OR 97203

Prepared by

319 SW Washington Street
Suite 1150
Portland, OR 97204

May 27, 2016

CONTENTS

LIST OF FIGURES ..... **iii**

LIST OF TABLES ..... **iv**

ACRONYMS AND ABBREVIATIONS ..... **v**

1 INTRODUCTION **1-1**

2 SUBSTRATE MONITORING AND MAINTENANCE OF THE BERM, BANK, AND UPPER BEACH **2-1**

2.1 MONITORING SCHEDULE 2-1
2.2 BERM AND BANK 2-2
2.3 UPPER BEACH 2-3
2.4 PHOTO DOCUMENTATION 2-3
2.5 REPORTING 2-4

3 NATIVE VEGETATION MONITORING AND MAINTENANCE **3-1**

3.1 MONITORING SCHEDULE 3-1
3.2 VEGETATION MONITORING 3-1
3.2.1 Riparian Vegetation Monitoring Methods 3-1
3.2.2 Vegetative Photograph Points 3-2
3.3 PERFORMANCE STANDARDS 3-3
3.4 MAINTENANCE ACTIVITIES 3-4
3.5 REPORTING 3-4
3.6 CONTINGENCY PLAN 3-5

4 ONSITE SOIL MANAGEMENT AREAS MONITORING AND MAINTENANCE **4-1**

4.1 EAST LANDFILL 4-1
4.2 MOLD BASEMENT 4-1

5 REFERENCES **5-1**

Appendix A. Monitoring Forms

Appendix B Seismic Design Report

Appendix C As-built Drawings

LIST OF FIGURES

Figure 1. Berm, Bank, Upper Beach Substrate, and Vegetation Monitoring Locations
Figure 2. Berm, Bank, Upper Beach Substrate, and Vegetation Monitoring Locations
Figure 3. On-Site Soil Management
Figure 4. Northern Monitoring Plot Spacing, Years 5, 7, 10
Figure 5. Northern-central Monitoring Plot Spacing, Years 5, 7, 10
Figure 6. Southern-central Monitoring Plot Spacing, Years 5, 7, 10
Figure 7. Southern Monitoring Plot Spacing, Years 5, 7, 10

LIST OF TABLES

Table 1. Riverbank Inspection and Monitoring Schedule

Table 2. Vegetation Monitoring, Upper Beach Substrate, and Bank Monitoring Locations

Table 3. Vegetation Performance Standards

Table 4. Soil Concentrations at East Landfill Soil Management Area

Table 5. Soil Concentrations in Mold Basement Soil Management Area

ACRONYMS AND ABBREVIATIONS

DEQ	Oregon Department of Environmental Quality
DSL	Oregon Department of State Lands
EES	Easement and Equitable Servitude
EOS	EVRAZ Oregon Steel
GPS	Global Positioning System
NGVD29	National Geodetic Vertical Datum of 1929
NOAA	National Oceanic and Atmospheric Administration
PCB	polychlorinated biphenyl
PGA	peak ground acceleration
ROD	record of decision
SCM	source control measure
USACE	U.S. Army Corps of Engineers
VCA	Voluntary Cleanup Agreement

1 INTRODUCTION

EVRAZ Oregon Steel (EOS) implemented a riverbank source control measure (SCM) under the June 2000 Voluntary Cleanup Agreement (VCA) between EOS and the Oregon Department of Environmental Quality (DEQ), and in accordance with the November 2014 riverbank SCM Record of Decision (ROD). This monitoring and maintenance plan (plan) describes long-term care of the EOS bank, upper beach, and berm following implementation of the riverbank SCM. The total project length encompasses 1,986 lineal ft of shoreline. The SCM included bank removal of soil/slag fill along 1,675 lineal ft of shoreline in sufficient quantity to achieve the required design slope. Following bank soil removal, the surface was stabilized with geotextile and crushed rock and protected with rock armor. Riverbank soil remaining beneath the armored cap was sampled prior to armor placement. Polychlorinated biphenyl (PCB) concentrations ranging from 1.6 to 5.8 mg/kg were detected in the bank soil remaining below the rock armor. In general, upper beach soils exceeding a concentration of 0.1 mg/kg for total PCBs were removed, and excavated beach areas were backfilled with well-graded river rock and sand. In select locations, remaining soils exceeding 0.1 mg/kg at a final excavation depth of 3 ft were left in-place and covered with 3 ft of granular beach backfill. Total PCB concentrations of remaining beach soil in these select areas ranges from 0.15 to 1.7 mg/kg.

Physical aspects of the riverbank SCM require long-term monitoring and maintenance, including:

- The structural integrity of the reconstructed bank, berm, and upper beach. The bank, berm, and beach must remain stable to protect areas with remaining PCB concentrations from exposure and erosion. In addition to a routine inspection and maintenance program, event-based inspections will be completed after floods or seismic events that approach or exceed the design criteria.
- The native vegetation growth and survival. For vegetation monitoring, the inspections assess density, survival, diversity, and coverage. Contingent actions are implemented as listed in the Vegetation Monitoring Plan (Grette 2014).

Soil removed from the beach was managed in the mold basement and on the north side of the east landfill. Soil excavated from the beach and placed in the mold basement had PCB concentrations ranging from <0.028 mg/kg to 9.3 mg/kg and was covered with a 6-in. cap of granular material. This plan includes inspection and maintenance or contingencies for augmentation of the mold basement cap. Soil excavated from portions of the beach with lower concentrations (PCB concentrations ranging from <0.020 mg/kg to 1.26 mg/kg) were placed on the east landfill and will be subject to maintenance and monitoring associated with the east landfill permit as described in Section 3.1.

An Easement and Equitable Servitude (EES) has been prepared and will be kept on file with the Multnomah County property deed. The EES addresses the long-term care to ensure the bank stabilization cap continues to prevent migration of contaminated soil, and habitat areas remain as habitat or are mitigated for if future reconstruction eliminates use as habitat.

2 SUBSTRATE MONITORING AND MAINTENANCE OF THE BERM, BANK, AND UPPER BEACH

Monitoring and maintenance of the berm, bank, and upper beach substrate will focus on the stability of the reconstructed bank, the riverward face of the berm in the project area, and the upper beach. Monitoring will assess stability and will determine the need for maintenance. Maintenance will be required when the bank or identified portions of the beach are compromised sufficiently such that soils beneath the rock armor cap could be exposed and eroded.

2.1 MONITORING SCHEDULE

Berm, bank, and upper beach inspections will be conducted to visually assess the condition of the bank rock armor and the reconstructed berm above the rock armor. Inspections will be completed:

- Semi-annually for Years 1 and 2
- Annually for Years 3, 4 5, 7, and 10
- When water recedes after the Willamette River rises above flood stage (currently 18 ft National Geodetic Vertical Datum of 1929 [NGVD29] at the Morrison Bridge gauge location)
- After a seismic event that approaches or exceeds the seismic design criteria of a peak acceleration of 0.19 g ('g' is the acceleration of gravity). For monitoring purposes, this will be considered a seismic event with a magnitude of 6.0 or larger that originates in the Portland area or after a magnitude 7.0 or greater subduction zone event.

The monitoring schedule is summarized on Table 1.

At Year 10, the performance and stability of the bank will be evaluated[1]. The riverward side of the berm, the rock armor cap, and upper beach/north alcove areas with monitoring stakes will be evaluated for the presence or absence of significant disturbance. If the riverbank action is performing sufficiently, periodic inspection and reporting will be eliminated. Inspections will continue as needed after floods, earthquakes, or any observations that suggest berm, bank, and upper beach instability. The riverbank stabilization must remain intact in perpetuity per the EES.

[1] If monitoring prior to year 10 suggests the stability of the bank is sufficient, EOS may request a reduced monitoring frequency prior to year 10.

2.2 BERM AND BANK

Monitoring of the berm and bank (to the base of the rock armor) will be conducted by walking the entire length of the project area. General berm and bank conditions will be noted, including any areas where sloughing, erosion, or geotextile indicator fabric are observed during inspections. The blank inspection form in Appendix A will be filled out. Photographs will be taken at pre-determined locations for inspections through Year 10 as noted in Section 2.4, and any location where bank or berm disturbances are observed. The southern riverbank removal area will be considered separately from the main stabilization area as this area was a removal action (rather than a stabilization) and slumping does not pose similar levels of risk.

Documentation will be submitted to the EOS Energy and Environment Department. If substantial disturbance or evidence of slumping is noted, EOS will have a registered Oregon professional engineer with applicable knowledge/experience (Engineer) review riverbank conditions and the need for maintenance or contingency measures. EOS, in cooperation with the Engineer, will coordinate any maintenance or contingency measures necessary to protect the stability of the rock armor layer on the bank and the berm. Maintenance and contingency measures will be documented and kept on file with inspection reports as noted in Section 2.5.

As indicated above, inspections of the berm and bank will also be conducted after the river rises above flood stage (18 ft NGVD29 at the Morrison Bridge), or after a seismic event that approaches or exceeds the design criteria which is a peak ground acceleration (PGA) of 0.19 g. For reference, the seismic design report is included as Appendix B to this plan. The riverbank may be subject to the design PGA from a number of different seismic events. Shallow crustal, interslab, and deep subduction zone earthquakes of different magnitudes and at different locations can produce the design level PGA at the riverbank area. It may take some time after an earthquake event to determine the actual PGA at the riverbank area that resulted from a particular event. With this in mind, this plan sets seismic events that may cause the design level PGA at the site as events that will require inspections. Inspections will be completed as soon as practical after a seismic event with a magnitude of 6.0 or larger that is listed as originating in the Portland area (typically a shallower event) or after a magnitude 7.0 or greater subduction zone event (typically an offshore event). Monitoring will follow the same procedures as the routine berm and bank inspections discussed above. Documentation will be submitted to the EOS Energy and Environment Department and any evidence of sloughing or failure will be reviewed by EOS and the Engineer. EOS will coordinate with the Engineer to complete appropriate maintenance or contingency measures necessary to protect the stability of the rock armor layer on the bank and the berm. Contingency measures will be documented and kept on file with inspection reports.

2.3 UPPER BEACH

The upper beach includes areas between 9.6 ft NGVD29 and the base of the riverbank rock armor. The elevation of the base of the riverbank rock armor is approximately 15 ft NGVD29 for the majority of the project length and increases to 25 ft NGVD29 in the north alcove. The entire length of the upper beach and north alcove will be visually inspected on the schedule noted above and on Table 1 to assess for scour or erosion of imported beach material. The blank inspection form provided in Appendix A will be filled out. Sorting and redistribution of beach substrate, including limited scour and erosion, are expected and will not be considered a cause for maintenance or contingent measures.

In three select locations where total PCB concentrations in soil exceed 0.10 mg/kg at depth of 3 ft below post-construction surface grade, white rebar marker stakes have been embedded below the final surface grade to monitor for scour (Figures 1 and 2). The top of each stake is embedded approximately 2 ft below the final post-construction beach grade, and 1 ft above the final excavation grade. Two of the upper beach areas with marker stakes are located in the north alcove between stations 4+00 and 5+25, and the third area is located in the upper beach north of the dock between stations 14+60 and 15+75. Identification stakes have been installed on the mill side of the berm east of the embedded beach marker stakes to assist inspectors with identifying the approximate location of the beach marker stakes. In the event that scour of the upper beach exposes the top 3 in. of any marker stakes, the locations will be documented in the substrate inspection form, the Engineer will be notified, and maintenance will be completed; likely, beach backfill will be placed to re-fill these areas[2] up to the approximate elevation shown in the as-built drawings (Appendix C).

If areas of excessive scour are observed on other portions of the upper beach or north alcove (areas where the total PCB concentrations in underlying soil were greater than 0.10 mg/kg as shown on Figures 1 and 2), they will be recorded and photographed. In the unlikely event that scour exposes the ground surface underneath the imported beach fill, the Engineer will be notified to determine if backfilling of these exposed areas is necessary to maintain stability of the rock armor. If necessary, backfill will be replaced[2] to the approximate elevation shown in the as-built drawings (Appendix C).

2.4 PHOTO DOCUMENTATION

Ten photograph points have been established to document changes in upper beach substrate over the monitoring period. Photograph points are depicted on Figures 1 and 2 and each location has been recorded with a global positioning system (GPS). Four additional locations

[2] For areas below ordinary high water, placement of beach material to an elevation specified in the design drawings will occur during an in-water work window, and the U.S. Army Corps of Engineers (USACE) and the Oregon Department of State Lands (DSL) will be notified.

will be photographed of the bank at the approximate locations shown on Figures 1 and 2, including three locations on the bank within the main project area and one location on the bank in the southern riverbank removal area. Photo points are permanently marked in the field with marker stakes (i.e., painted rebar) located at the base of the rock armor slope. At least four photographs will be taken from each photo point to document bank conditions surrounding each photo point. Berm conditions will be documented through vegetation photo documentation.

2.5 REPORTING

A bank, berm, and upper beach substrate inspection report will be generated following inspections and will be maintained on file at the EOS Energy and Environment Department. At a minimum, these reports will include a completed inspection form and associated photographs, and will document any observed sloughing, erosion, or observations of geotextile indicator fabric. Measures to address sloughing, erosion or other material movement and associated reporting will be reviewed and approved by an Engineer.

3 NATIVE VEGETATION MONITORING AND MAINTENANCE

As part of the riverbank SCM, 1.74 acres of native riparian trees and shrubs have been planted above +28.5 ft NGVD29 on the bank and berm areas. In addition, 0.73 acre of native trees and shrubs have been planted on the upper beach between +15 and +12 ft NGVD29 and up to +25 ft NGVD29 in the north alcove. To ensure the establishment and continued development of these habitats, EOS will conduct monitoring of the vegetation and replacement of vegetation, as necessary, to meet the survival and density requirements outlined in this plan. This native vegetation monitoring and maintenance plan is adapted from the Native Vegetation Monitoring Plan prepared for this SCM by Grette Associates in June 2014 (Grette 2014).

3.1 MONITORING SCHEDULE

Monitoring will occur annually, in Years 1 through 5, and in Years 7 and 10, as indicated on Table 1.

Survival will be evaluated at Year 10 and, provided growth is sufficient, the area will be maintained as habitat in perpetuity per the EES.

3.2 VEGETATION MONITORING

3.2.1 Riparian Vegetation Monitoring Methods

Monitoring of the riparian vegetation during the 10-year period following the completion of construction will include a determination of plant density, percent survival, species diversity, percent coverage of planted species, and percent coverage of invasive species. Upland/riparian vegetation monitoring will be conducted in mid-summer, between July 1 and August 15 of each monitoring year. The blank monitoring form included in Appendix A will be completed.

The condition of vegetation at the riverbank will be evaluated by monitoring selected plots along seven transects of the riverbank. The seven transects established for the 10-year monitoring period are shown on Figures 1 and 2. Transects are spaced approximately 260 ft apart and oriented perpendicular to the river, from the inland extent of the berm planting area riverward/down to the lower end of the beach planting area (no data will be collected on the rock armor section between +15 or +25 and +28.5 NGVD29). Each transect is identified with permanent orange-painted rebar identifier stakes driven to approximately 1.0 ft above ground surface. Two orange rebar marker stakes are located on each transect, one on the inland extent of the berm planting area and the second at the base of the rock armor on the upper beach and north alcove. In addition to the orange rebar identifier stakes, permanent monitoring location stakes (orange-colored snow stakes) are located on the berm, upper beach, and north alcove at

15-ft intervals between the inland end/top and bottom of each transect. The bottom of each transect on the upper beach ranges from 10 ft to 13 ft NGVD29. Transect location information is provided in Table 2. There are no stakes located within the rock armor section. A 10- by 10-ft area (monitoring plot) will be evaluated around each stake.

In Years 1 through 4, monitoring plots on each transect will be evaluated to assess density and percent survival of native trees and shrubs, percent cover of native herbaceous species, and the presence of noxious weeds/invasive species. Data to be collected and recorded on the monitoring form will include number of native trees and shrubs within the sampling plot, number of species per sampling plot, percent cover of native herbaceous species, and percent cover of noxious/invasive herbaceous species and shrubs. Density will be calculated as number of living trees and shrubs on each 10- by 10-ft monitoring plot. Percent survival will be calculated by counting the number of trees and shrubs in each monitoring plot at the time of planting (as-built count), then for each plot comparing each monitoring year's count to the as-built count. An average percent survival of all monitoring plots will constitute the site's percent survival. Data will be compared to the performance standards described in Section 2.3 to determine if maintenance or contingency measures are required.

In Years 5, 7, and 10, density data will not be collected, and collection of percent cover data for tree and shrub species will begin. Evaluation of percent survival of native trees and shrubs, cover of herbaceous species, and the presence of noxious weeds/invasive species in the 10- by 10-ft monitoring plots will continue. Percent cover for shrub species will also be evaluated using the 10- by 10-ft monitoring plots. For tree species percent cover, a 30-ft-diameter plot will be used. One plot will be located every 45 ft along each transect, starting at least 15 ft in from the inland end of the transect to ensure the whole plot is located within the planting area (Figures 4 through 7). Monitoring plot spacing is consistent with National Oceanic and Atmospheric Administration (NOAA) protocols for vegetation monitoring in the Lower Columbia River and estuary (NOAA 2009). This is a reduction in plot size and frequency from the 2014 vegetation monitoring plan (Grette 2014) to ensure no overlap between the plots.

In addition to evaluating the monitoring plots, the percent coverage of invasive species that are problematic to the area (e.g., reed canary grass, Himalayan blackberry, Scot's broom) will be noted within the riparian planting area as a whole and within the 10-ft buffer around the landward side of the riparian planting area and above ordinary high water (OHW), 16.6 ft NGVD29. The inspector will note if the percentage of invasive species that are problematic to the area exceed 10 percent aerial cover in any portion of the Riparian Zone planting area or within the 10-ft buffer.

3.2.2 Vegetative Photograph Points

Vegetation will be documented with photographs at each of the 10- by 10-ft monitoring plots shown on Figures 1 and 2. The monitoring plots/photograph points are marked with permanent

orange-colored snow stakes. Two photographs will be taken at each of the monitoring plots. The top and bottom of each of the seven transects are surveyed and these coordinates are provided in Table 2.

3.3 PERFORMANCE STANDARDS

The monitoring results will be compared to the performance standards, maintenance actions will be completed, and contingency actions will be considered. Performance standards establish long-term native vegetation growth and survival criteria, as indicated below and summarized on Table 3.

Years 1 through 4:

1. There shall be 75% survival of all planted trees and shrubs.
2. Density of shrubs and trees will be at least 1,500 shrubs/trees per acre in both planting areas. During the first 4 years, trees and shrubs will be excluded from percent cover. Density of trees and shrubs will not be monitored after Year 4.
3. At least 60% cover of native herbaceous species.
4. No more than 10% cover noxious/invasive herbaceous species.
5. No more than 10% cover noxious/invasive shrub species.

Years 5 and 7:

1. There shall be 75% survival of all planted trees and shrubs.
2. At least 50% cover of trees in overstory.
3. At least 30% cover of native herbaceous species.
4. At least 50% cover of native shrubs.
5. No more than 10% noxious/invasive herbaceous species.
6. No more than 5% noxious/invasive shrub species.

Year 10:

1. There shall be 75% survival of all planted trees and shrubs and
    a. There shall be a minimum of 1.31 acres of riparian tree/shrub plantings above +28.5 ft NGVD29 (equivalent to 75% survival).
    b. There shall be a minimum of 0.55 acre of planting area below +15 ft NGVD29 in the main upper beach planting area and below +25 in the north alcove area (equivalent to 75% survival).

2. At least 80% cover for tree species in overstory.
3. At least 20% cover for native herbaceous species.
4. At least 70% cover for native shrub species.
5. No more than 5% cover for non-native herbaceous species and shrubs.

3.4 MAINTENANCE ACTIVITIES

If inspections indicate noxious weeds and other exotic plants (e.g., reed canary grass, Himalayan blackberry, Scot's broom) that exceed an estimated 10 percent areal cover, these plants will be removed from the planting areas as well as within a 10-ft non-native plant clearance area around the Riparian Zone planting area. Noxious vegetation to be removed from within the planting areas would be removed by non-chemical means. Approved herbicides in compliance with the Portland Parks Integrated Pest Management Policy for waterways may only be used within the 10-ft non-native plant clearance area located on the top or landward side of the Riparian Zone planting area and above OHW (Figures 1 and 2). The following best management practices will be implemented during herbicide application to ensure that no herbicides enter the river:

- Herbicide use will be limited to periods of low water, either in the spring prior to high flows or in the later summer after high flows.
- Herbicides will not be applied in windy conditions to limit the potential for overspray to be blown into unintended areas.
- Herbicides will not be applied during precipitation, or when precipitation is forecast, to limit the potential for herbicides to enter the river via runoff.

During Year 1, if survival of planted trees and shrubs does not meet performance criteria, trees or shrubs will be replanted to exceed criteria without developing and submitting a contingency plan as identified in Section 3.6.

3.5 REPORTING

Vegetation monitoring reports will be submitted to DEQ, USACE, and DSL by December 15 of each monitoring year (Years 1 through 5, 7, and 10). The monitoring reports will document the monitoring activities that were performed, the results of the monitoring with a comparison to the performance standards, and changes that have occurred within the planting areas. Also, the monitoring reports will either document maintenance completed or provide recommendations for improvements and/or corrective measures for any problems noted during the monitoring visits per the contingency plan in Section 3.6.

3.6 CONTINGENCY PLAN

This contingency plan provides a strategy to address unforeseen changes in site conditions or other components of the planting areas, as well as a framework for taking action if the planting areas fail to meet performance standards. Careful attention to maintenance is essential to meet standards and to minimize the potential for failure. Should any portion of the planting areas fail to meet the success criteria, a contingency plan will be developed and implemented with USACE and DSL approval. Such plans are prepared on a case-by-case basis to reflect the failed enhancement characteristics. The contingency plan would include the following steps:

1. Identify potential contingency actions based on an analysis of the cause of the shortfall
2. Initiate contingency planning procedures, consisting of:
    a. A problem recognition process to determine if there is a problem and if so, the nature and extent of the problem
    b. A contingency planning and response process to develop and implement contingency actions as necessary, depending on the results of the monitoring program and problem recognition step.

Any selected contingency action would vary depending on whether physical or biological processes are responsible for non-attainment of performance standards and the level of shortfall. If the project fails one or more performance standards, but the permitting agencies agree the shortfall is minor, additional monitoring prior to undertaking more intense corrective actions may be proposed. If additional monitoring indicates that more intense corrective actions may be implemented, contingency actions may include, but are not limited to:

1. Using some or all of the approximately 8.1 Discounted Service Acre-Year net positive credits created by the project toward addressing shortfalls
2. Replacing, as necessary, plants lost to vandalism, drought, or disease
3. Replacing any plant species with a 20% or greater mortality rate after two growing seasons with the same species or species approved by DSL
4. Continue irrigating the planting areas only as necessary during dry weather if plants appear to be too dry
5. Removing all trash or undesirable debris from the buffer areas as necessary.

4 ONSITE SOIL MANAGEMENT AREAS MONITORING AND MAINTENANCE

The two onsite soil management areas include a narrow strip of unused land on the north side of the east landfill, and a concrete-lined, unused basement in the former melt shop (mold basement). Excavated berm and beach soils meeting site-specific upland surface and subsurface soil management screening criteria for PCBs were placed at each of these locations as described in the Upland Soil Management Plan (Attachment C of the Construction Completion Report). The upper beach and berm soil placed in the onsite soil management areas are shown on Figure 3. EOS will implement monitoring and maintenance for each of these soil management areas, as described below.

4.1 EAST LANDFILL

Excavated berm and beach soils meeting site-specific upland surface and subsurface soil management screening criteria for PCBs were transported to the north side of the east landfill and managed onsite (Table 4). Approximately 4,700 cubic yards of beach soils were placed along the north side of the east landfill in 18-in. lifts and compacted to a non-yielding surface. A geotextile indicator fabric was placed on top of the compacted beach material. Approximately 1,600 cubic yards of berm soil meeting upland surface management screening criteria was placed over the indicator fabric in a 1-ft-thick layer to cap the beach material and serve as a medium for grass growth. Following placement of all excavated berm material, additional capping/growing medium was needed to cover approximately one-third of the compacted beach material and geotextile. Jute matting was placed over the soil cap and hydroseeded to stabilize the newly placed fill (Integral and Crete 2016).

DEQ approved placement of this soil on the side of a DEQ-permitted landfill. Management and monitoring of the soil placed on the landfill will be conducted in conjunction with, and in accordance with, the conditions set forth in solid waste letter authorization permit no. 1326, dated September 23, 2005. This includes quarterly surface visual inspections after the first year of construction, and annual inspections thereafter (Table 1). Inspections for the first four quarters will be documented on the onsite soil management log form provided in Appendix A and maintained on file at the EOS Energy and Environment Department. Subsequent annual inspections will be included in the overall landfill inspection requirements.

4.2 MOLD BASEMENT

Excavated beach soils meeting site-specific upland subsurface soil management screening criteria for PCBs were transported to the mold basement and managed onsite (Table 5).

Approximately 3,700 cubic yards of excavated beach material from the upper beach and from the excavation for construction of the toe of the rock armor was placed and compacted in the mold basement. Beach fill was placed and compacted in lifts in the mold basement within approximately 8 in. of surrounding surface grade. A geotextile indicator fabric was placed on top of the compacted soil, and 6 in. of imported crushed rock was placed and compacted on top of the indicator fabric (Integral and Crete 2016).

Annual inspections will be conducted to confirm the 6-in. crushed rock remains intact and the indicator fabric is not exposed (Table 1). EOS may request DEQ concurrence to decrease in inspection frequency based on proven performance of the gravel cover or replacement of the gravel cover with a more permanent treatment. Inspections will be documented on the onsite soil management log form provided in Appendix A. Should the indicator geotextile fabric be exposed or the gravel be less than 3 in. thick, additional gravel will be placed to amend the area. Should EOS elect to amend the gravel surface with concrete or asphalt without removing the existing gravel cover, DEQ will be notified. In the event EOS reconfigures the mold basement in a way that removes portions of the managed soil or existing gravel cover, EOS will provide DEQ with a plan for soil handling and capping prior to completing construction.

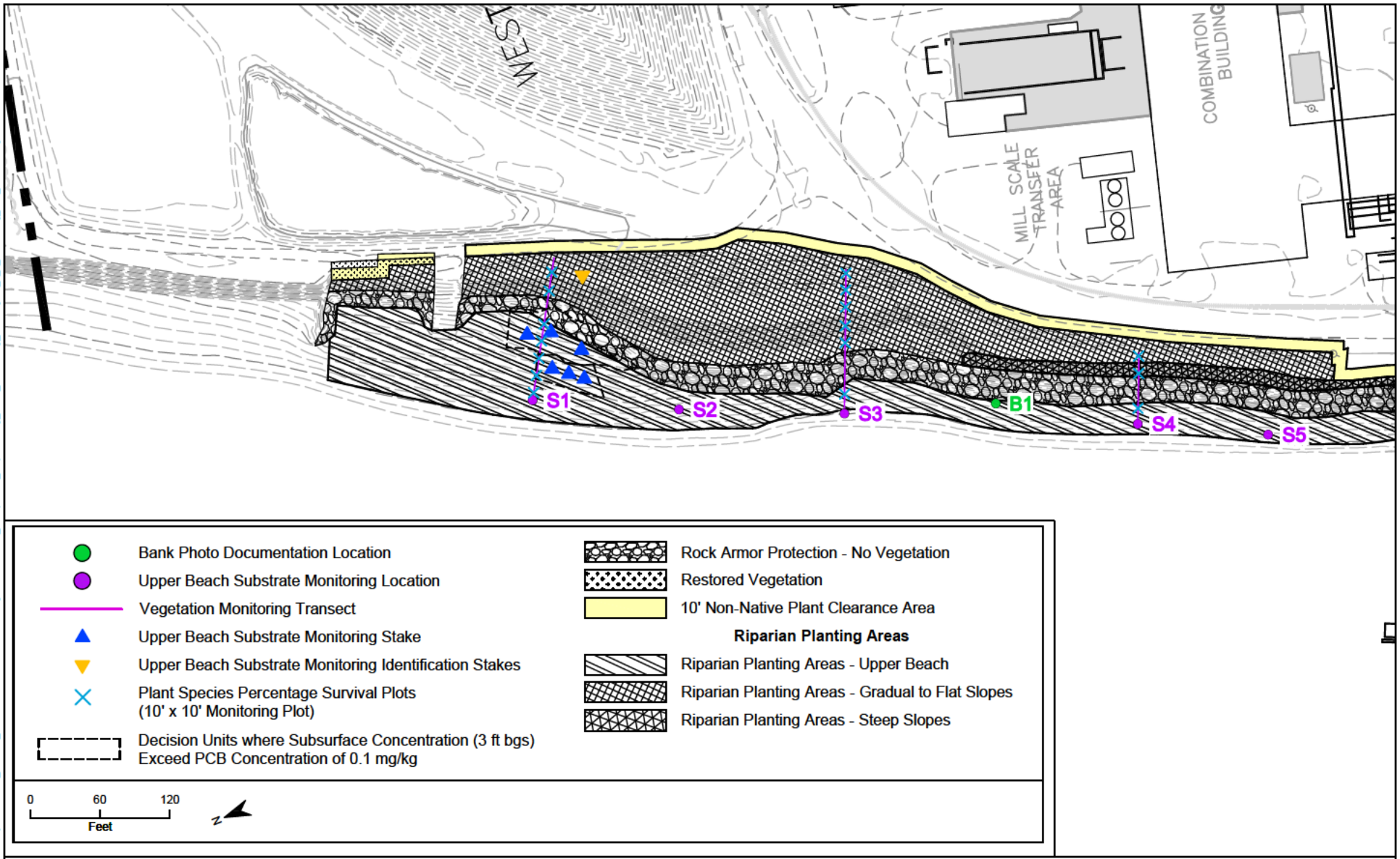
5 REFERENCES

Grette. 2014. Riverbank stabilization at EVRAZ Oregon Steel: An interim remedial measure, biological assessment, native vegetation monitoring plan. Grette Associates Environmental Consultants, Wenatchee, Washington. October 8.

Integral and Crete. 2016. Riverbank source control measure completion report, EVRAZ Oregon Steel. Prepared for EVRAZ Oregon Steel, Portland, OR. Integral Consulting Inc., Portland, OR, and Crete Consulting, Inc., Seattle, WA. May.

NOAA. 2009. NOAA technical memorandum NMFS-NWFSC-97, protocols for monitoring habitat restoration projects in the Lower Columbia River and estuary. February.

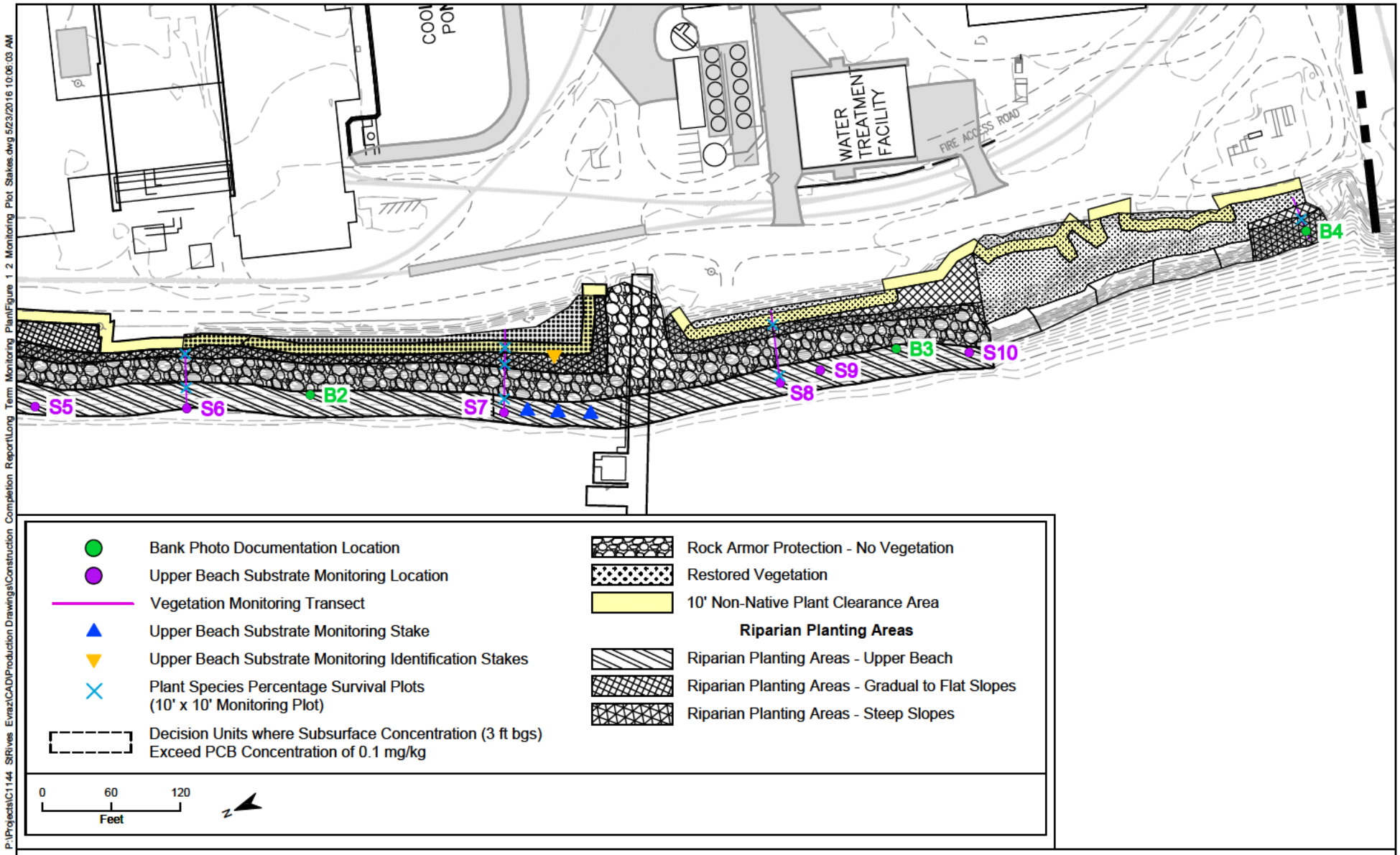
FIGURES



P:\Projects\C1144_StRives_Evraz\CAD\Production Drawings\Construction_Completion_Report\Long_Term_Monitoring_Plan\Figure_1_2_Monitoring_Plot_Stakes.dwg 5/23/2016 10:06:03 AM

integral consulting inc.

Figure 1.
Berm, Bank, Upper Beach Substrate, and Vegetation Monitoring Locations
EVRAZ Oregon Steel
Portland, OR



integral consulting inc.

Figure 2.
Berm, Bank, Upper Beach Substrate, and Vegetation Monitoring Locations
EVRAZ Oregon Steel
Portland, OR

Project Area

Upland Soil Management Designation

East Landfill - Subsurface

East Landfill - Surface

Mold Basement

Upland Soil Management Area

East Landfill

Mold Basement

0 100 200 Feet

N

East Landfill Management Area

Mold Basement Management Area

Sta. 6+25

Sta. 9+50

Sta. 10+50

Sta. 11+40

Sta. 12+50

Sta. 15+50

WEST LANDFILL

EAST LANDFILL

COIL STORAGE

OUT TO LENGTH FACILITY

ACCESS ROAD

GYM

MILL SCALE TRANSFER AREA

COMBINATION MILL BUILDING

COIL YARD

COIL STORAGE

MATERIAL PROCESSING

DOWN COILER

SUBSTATION, MCC, & FANS

PLATE ROLLING MILL

SHIPPING BAY

SHIP OFFICES

REHEAT COOLING TOWERS

SLAB STORAGE

COOLING POND

TEST LAB

FUELING PAD

MELT SHOP

ELECTRICAL MAINTENANCE FACILITY

WASTE TRANSFER

#2 BAGHOUSE

#1 BAG HOUSE

MAIN SUBSTATION

SLAB STORAGE

WATER TREATMENT FACILITY

EMPLOYEE PARKING

COATING MILL

STOREHOUSE & MAINTENANCE SHOP

P:\Projects\C1144_StRives_Evraz\Production_MXDs\Construc ion_Completion_Report\MonitoringPlan\Figure_3_Soil_Management.mxd 4/15/2016 9:19:12 AM

integral consulting inc.

Figure 3.
On-Site Soil Management
EVRAZ Oregon Steel
Portland, OR

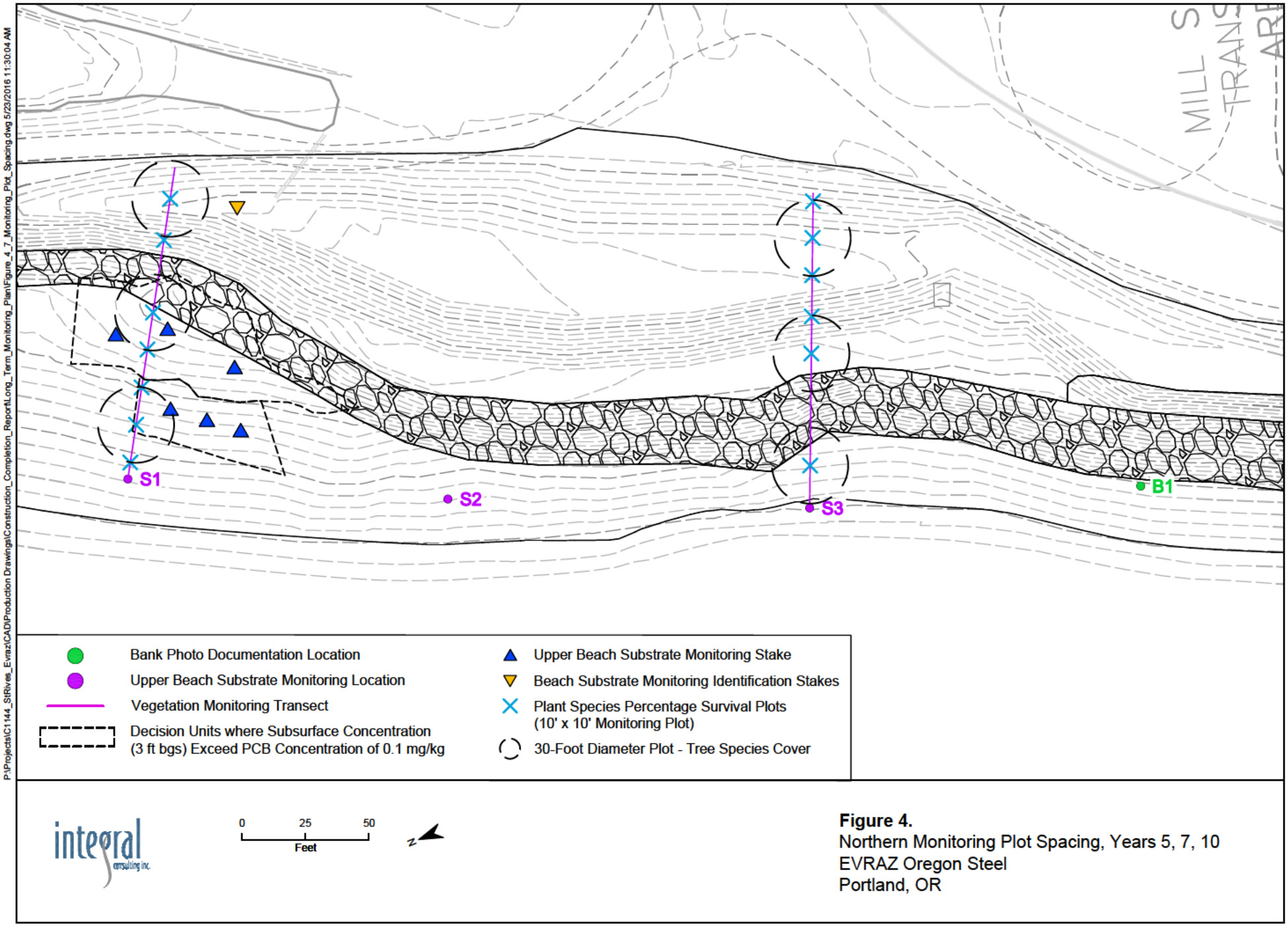
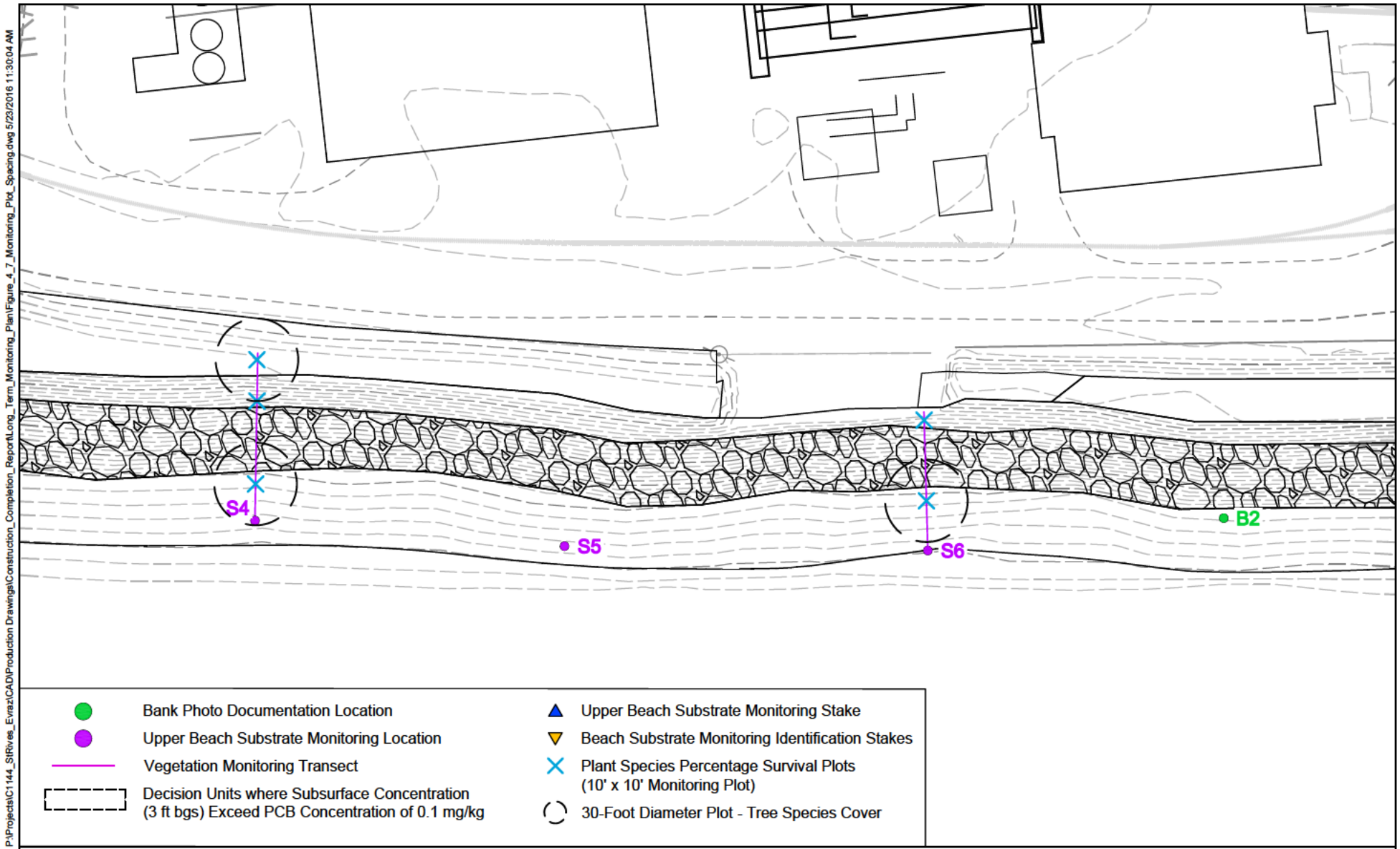


Figure 4.
Northern Monitoring Plot Spacing, Years 5, 7, 10
EVRAZ Oregon Steel
Portland, OR



P:\Projects\C1144_StRivas_Evraz\CAD\Production Drawings\Construction_Completion_Report\Long_Term_Monitoring_Plan\Figure_4_7_Monitoring_Plot_Spacing.dwg 5/23/2016 11:30:04 AM

Figure 5.
Northern-central Monitoring Plot Spacing, Years 5, 7, 10
EVRAZ Oregon Steel
Portland, OR

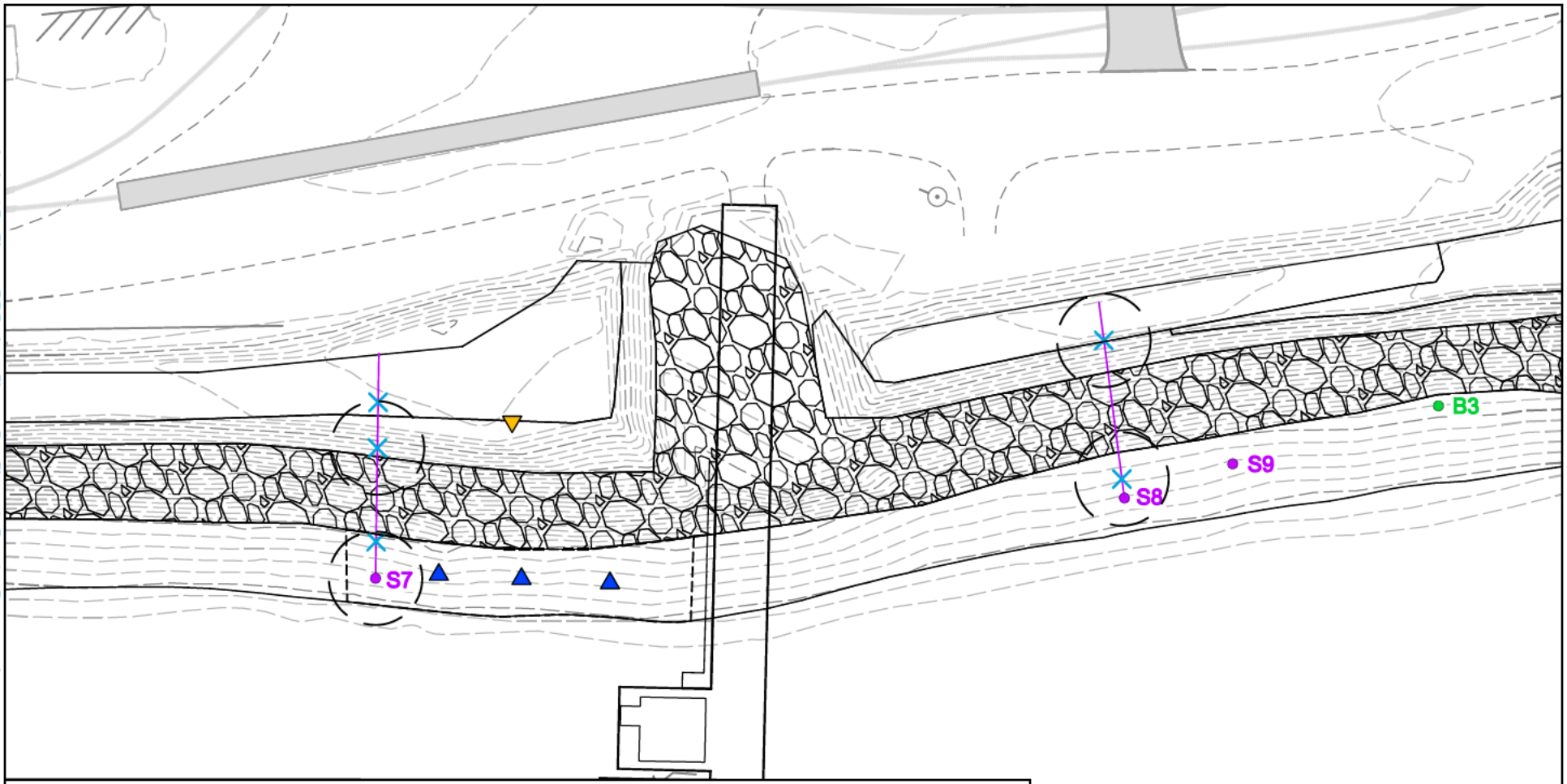
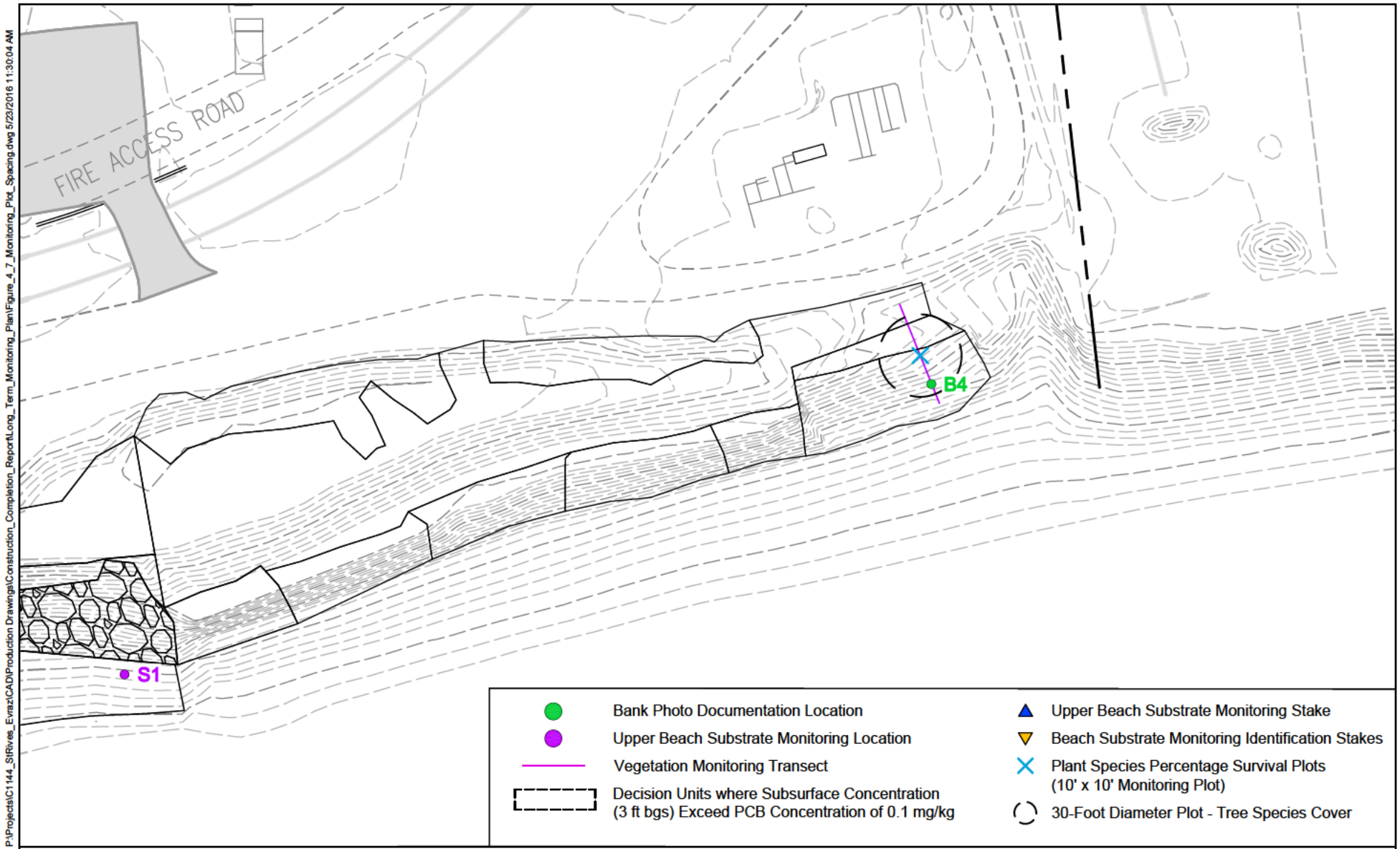


Figure 6.
Southern-central Monitoring Plot Spacing, Years 5, 7, 10
EVRAZ Oregon Steel
Portland, OR



P:\Projects\C1144_StRivas_Evraz\CAD\Production Drawings\Construction_Completion_Report\Long_Term_Monitoring_Plan\Figure_4_7_Monitoring_Plot_Spacing.dwg 5/23/2016 11:30:04 AM

Figure 7.
Southern Monitoring Plot Spacing, Years 5, 7, 10
EVRAZ Oregon Steel
Portland, OR

TABLES

Table 1. Riverbank Inspection and Monitoring Schedule

Monitoring Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Vegetation Monitoring	Annual	Annual	Annual	Annual	Annual	None	Annual	None	None	Annual
Upper Beach Substrate Monitoring	Semi-Annual	Semi-Annual	Annual	Annual	Annual	None	Annual	None	None	Annual
Berm and Bank Inspection	Semi-Annual	Semi-Annual	Annual	Annual	Annual	Annual	Annual	Annual	Annual	Annual
East Landfill	Quarterly	Annual[1]	Annual[1]	Annual[1]	Annual[1]	Annual[1]	Annual[1]	Annual[1]	Annual[1]	Annual[1]
Mold Basement	Annual	Annual	Annual	Annual	Annual	Annual	Annual	Annual	Annual	Annual

[1] East Landfill inspections will be completed under Solid Waste Letter Authorization Permit No. 1326

Table 2. Vegetation, Upper Beach Substrate, and Bank Monitoring Locations

Plot/Stake ID	Type	Location Coordinates X	Location Coordinates Y	Elevation ft NGVD 29
Upper Beach Substrate Monitoring Locations[a]				
S1	Permanent Monitoring Plot - Beach	1415923.335	724625.093	13.18
S2	Additional Beach Monitoring Plot	1415869.598	724511.033	13.11
S3	Permanent Monitoring Plot - Beach	1415812.315	724380.037	10.14
S4	Permanent Monitoring Plot - Beach	1415709.327	724148.777	11.59
S5	Additional Beach Monitoring Plot	1415659.129	724048.017	11.58
S6	Permanent Monitoring Plot - Beach	1415607.685	723926.247	10.19
S7	Permanent Monitoring Plot - Beach	1415501.053	723671.633	11.57
S8	Permanent Monitoring Plot - Beach	1415434.861	723439.055	11.85
S9	Additional Beach Monitoring Plot	1415432.589	723402.709	12.77
S10	Additional Beach Monitoring Plot	1415398.011	723276.823	14.52
Upper Beach Substrate Embedded Monitoring Stake				
MS-1	Beach Substrate Monitoring Stake	1415938.264	724599.5775	18.62
MS-2	Beach Substrate Monitoring Stake	1415928.855	724587.9482	18.11
MS-3	Beach Substrate Monitoring Stake	1415920.061	724577.0818	17.39
MS-4	Beach Substrate Monitoring Stake	1415973.636	724608.5765	23.07
MS-5	Beach Substrate Monitoring Stake	1415967.963	724588.855	24.72
MS-6	Beach Substrate Monitoring Stake	1415944.057	724570.0215	22.89
MS-7	Beach Substrate Monitoring Stake	1415490.49	723652.5367	12.78
MS-8	Beach Substrate Monitoring Stake	1415479.323	723628.4475	12.24
MS-9	Beach Substrate Monitoring Stake	1415467.396	723602.6175	12.23
Upper Beach Substrate Monitoring Stake Location Identifiers				
ID-1	Berm Reference Location	1416003.508	724544.5925	40.58
ID-2	Berm Reference Location	1415527.381	723611.9356	38.57

Table 2. Vegetation, Upper Beach Substrate, and Bank Monitoring Locations

Plot/Stake ID	Type	Location Coordinates X	Location Coordinates Y	Elevation ft NGVD 29
Vegetation Monitoring Transect Start Locations				
T1	Transect Start Location - Berm	1416030.193	724561.916	36.04
T2	Transect Start Location - Berm	1415926.898	724332.269	35.6
T3	Transect Start Location - Berm	1415765.396	724125.008	37.64
T4	Transect Start Location - Berm	1415654.892	723908.674	33.6
T5	Transect Start Location - Berm	1415567.581	723643.593	39.1
T6	Transect Start Location - Berm	1415496.117	723423.124	39
T7	Transect Start Location - Berm	1415417.075	722965.372	28.92
Bank Photo Documentation Location				
B1	Photo Documentation Location - Bank	1415767.518	724255.7244	10.92
B2	Photo Documentation Location - Bank	1415574.392	723822.1678	12.98
B3	Photo Documentation Location - Bank	1415420.606	723334.496	12.92
B4	Photo Documentation Location - Bank	1415381.947	722965.5444	18.93

Notes:

Location coordinates provided in Oregon State Plane North, NAD27 (ft)

[a]Monitoring locations S1, S3, S4, S6, and S7 also represent the upper beach end of the vegetation monitoring transects.

Table 3. Vegetation Performance Standards

Monitoring Year	2016	2017	2018	2019	2020	2022	2025
Percent tree and shrub survival	75%	75%	75%	75%	75%	75%	75%
Tree and shrub density (per acre)	≥ 1,500	≥ 1,500	≥ 1,500	≥ 1,500	--	--	--
Percent cover, herbaceous	≥ 60%	≥ 60%	≥ 60%	≥ 60%	≥ 30%	≥ 30%	≥ 20%
Percent cover, shrub	--	--	--	--	≥ 50%	≥ 50%	≥ 70%
Percent cover, tree	--	--	--	--	≥ 50%	≥ 50%	≥ 80%
Percent cover, noxious/invasive herbaceous	≤ 10%	≤ 10%	≤ 10%	≤ 10%	≤ 10%	≤ 10%	≤ 5%
Percent cover, noxious/invasive shrub	≤ 10%	≤ 10%	≤ 10%	≤ 10%	≤ 5%	≤ 5%	≤ 5%

Table 4. Soil Concentrations in East Landfill Soil Management Area

		PCBs (in mg/kg)	Metals (in mg/kg)							
		Total PCBs	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Zinc	
Subsurface Soil Reuse Criteria:		8.8	13	150	460,000	12,000	800	14,609	NA	
Surface Soil Reuse Criteria:		0.85	8.8	150	460,000	12,000	800	14,609	NA	
Stationing	Fill Unit	Total PCBs (mg/kg)								Reuse Criteria Exceedance
2+50 - 6+25	Beach	<0.099	2.6	0.11	32.9	28.3	6.39	660	60.5	None
2+50 - 6+25	Beach	<0.099	3	0.1	30.7	27.8	4.71	578	66.3	None
2+50 - 6+25	Beach	0.06	NA	NA	NA	NA	NA	3,540	NA	None
2+50 - 6+25	Beach	<0.10	1.1	0.12	5	6	3.25	137	38	None
2+50 - 6+25	Beach	1.43	2.3	0.81	69.6	29	60.5	1,650	268	Surface
2+50 - 6+25	Beach	0.10	2.2	0.22	12	12.8	9.61	805	84	None
2+50 - 6+25	Beach	0.21	1.4	0.14	10.4	8	4.73	201	46.4	None
2+50 - 6+25	Beach	0.13	1.6	0.24	18.8	16.4	13.9	230	99.5	None
2+50 - 6+25	Beach	0.47	3	0.54	99.5	36.8	41.1	2,540	189	None
2+50 - 6+25	Beach	0.81	4.6	<1	640	102	<20.8	NA	116	None
9+50-10+50	Beach	0.05	NA	NA	NA	NA	NA	843	30.3	None
9+50-10+50	Beach	<0.098	1	0.1	5.2	5.2	2.4	147	32	None
9+50-10+50	Beach	0.57	3.3	0.21	93.1	20.4	7.95	2,690	56.9	None
11+40-12+50	Beach	0.44	NA	NA	NA	NA	NA	NA	NA	None
11+40-12+50	Beach	0.88	2.6	0.52	75.7	144	25	1,220	744	Surface
11+40-12+50	Beach	0.19	132	2.1	223	103	103	NA	823	Subsurface
15+50-19+15	Beach	0.02	NA	NA	NA	NA	NA	268	NA	None
15+50-19+15	Beach	<0.087	1.8	0.14	7.8	16.6	4.52	370	45.7	None
15+50-19+15	Beach	0.78	2.2	0.36	86.4	22.1	22.2	1,760	128	None
15+50-19+15	Beach	0.26	2	0.33	28.2	27.4	20.3	629	125	None
15+50-19+15	Beach	<0.098	2.5	0.14	7.7	9.84	5.59	718	47.8	None
15+50-19+15	Beach	0.029	9.1	0.53	46.5	20.9	12.5	19,600	76.3	Subsurface
15+50-19+15	Beach	<0.099	7.7	0.43	58.4	26.9	9.55	21,700	67.3	Subsurface
15+50-19+15	Beach	0.193	2.2	0.14	24.1	14.6	9.09	999	65.4	None
15+50-19+15	Beach	0.43	NA	NA	321	NA	NA	34,000	NA	Subsurface
11+40-12+50	Beach	<0.027	2.57	0.21	209	31.3	18.7	2,890	88.3	None
11+40-12+50	Beach	0.006	3.73	0.172	18.7	18	7.69	396	67.8	None
11+40-12+50	Beach	0.012	3.81	0.204	23.3	19.2	8.64	519	69.7	None
2+50 - 6+25	Northern alcove	<0.021	4.22	0.126	30	29.3	7.25	515	58.2	None
2+50 - 6+25	Northern alcove	<0.032	4.98	0.085	31.7	35.2	5.7	678	59.5	None
2+50 - 6+25	Northern alcove	0.49	5.27	0.412	59.6	31.9	17.9	989	108	None
2+50 - 6+25	Northern alcove	0.043	3.13	0.167	17.5	16.5	5.94	732	53.5	None
2+50 - 6+25	Northern alcove	<0.028	4.43	0.1	29.2	23.5	7.35	569	56.7	None
2+50 - 6+25	Northern alcove	0.034	1.95	0.16	11.6	9.92	5.21	221	50.9	None

Table 4. Soil Concentrations in East Landfill Soil Management Area

		PCBs (in mg/kg)	Metals (in mg/kg)							
		Total PCBs	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Zinc	
Subsurface Soil Reuse Criteria:		8.8	13	150	460,000	12,000	800	14,609	NA	
Surface Soil Reuse Criteria:		0.85	8.8	150	460,000	12,000	800	14,609	NA	
Stationing	Fill Unit	Total PCBs (mg/kg)								Reuse Criteria Exceedance
2+50 - 6+25	Northern alcove	0.61	4.17	1.64	62.9	31.1	136	1,340	400	None
2+50 - 6+25	Northern alcove	0.12	2.37	0.515	78.5	17	47.8	912	177	None
2+50 - 6+25	Northern alcove	0.050	2.83	0.263	22.8	14	12	381	79.7	None
8+10-15+50	Berm	<0.021	NA	NA	NA	NA	NA	NA	NA	None
8+10-15+50	Berm	0.12	4.52	0.399	95.9	29.3	13.2	1,060	87.7	None
8+10-15+50	Berm	0.21	4.54	0.346	171	36.3	13.6	1,790	94.6	None
8+10-15+50	Berm	<0.021	NA	NA	NA	NA	NA	NA	NA	None
8+10-15+50	Berm	1.3	NA	NA	NA	NA	NA	NA	NA	Surface
16+15-18+90	Berm	0.12	9.49	1.06	335	130	10.3	3,090	76.3	Surface
16+15-18+90	Berm	<0.020	NA	NA	NA	NA	NA	NA	NA	None
16+15-18+90	Berm	0.074	4.45	0.254	89.7	21.8	8.98	845	76.1	None
2+65 - 6+25	Toe	0.080	2.95	0.281	<11.6	7.95	18.9	218	107	None
2+65 - 6+25	Toe	0.16	2.71	<0.112	<9.5	8.48	5.14	202	51	None
15+50-19+15	Toe	0.042	5.54	<0.135	<9.5	18.6	5.6	334	52.1	None
15+50-19+15	Toe	0.35	5.51	1.26	515	39.2	62	14,500	306	None
15+50-19+15	Toe	<0.020	NA	NA	NA	NA	NA	NA	NA	None

Notes:
NA = not applicable
PCB = polychlorinated biphenyl

Table 5. Soil Concentrations in Mold Basement Soil Management Area

		PCBs (in mg/kg)	Metals (in mg/kg)							
		Total PCBs	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Zinc	
Subsurface Soil Reuse Criteria:		8.8	13	150	460,000	12,000	800	14,609	NA	
Surface Soil Reuse Criteria:		0.85	8.8	150	460,000	12,000	800	14,609	NA	
Stationing	Fill Unit	Total PCBs (mg/kg)								Reuse Criteria Exceedance
6+25-9+50	Beach	4.30	4.4	2.28	1,530	34.6	197	14,000	805	Surface
6+25-9+50	Beach	4.60	4.4	2.43	194	51.7	237	6,460	509	Surface
6+25-9+50	Beach	0.12	2.1	0.32	37.2	12	12	3,680	96	None
6+25-9+50	Beach	0.17	20.1	0.47	16.4	31.3	29	5,140	122	Subsurface
11+40-12+50	Beach	<0.20	1.8	<1.1	13.1	11.1	<21	NA	43.1	None
11+40-12+50	Beach	0.55	6.6	<1.1	252	145	166	NA	209	None
12+50-15+50	Beach	0.01	NA	NA	NA	NA	4.86	NA	61.2	None
12+50-15+50	Beach	0.06	1.4	0.24	7.5	10	15.7	241	75.7	None
12+50-15+50	Beach	3.30	NA	NA	NA	NA	185	NA	773	Surface
12+50-15+50	Beach	0.03	NA	NA	NA	NA	NA	NA	NA	None
12+50-15+50	Beach	0.22	1.1	0.18	7.7	5.1	4.43	196	53.4	None
12+50-15+50	Beach	9.30	NA	NA	NA	NA	NA	NA	NA	Subsurface
6+25-9+50	Beach	0.87	10.6	1	148	56	48	1,830	184	Surface
6+25-9+50	Beach	<0.028	2.68	0.093	31.2	28	6.63	289	57.2	None
6+25-9+50	Beach	0.97	4.73	0.39	49.7	27.8	24.4	1,130	127	Surface
6+25-9+50	Beach	0.561	5.14	0.425	74.8	31.1	25.5	1260	149	None
6+25-9+50	Beach	<0.021	5.43	0.238	31.3	34.9	20	460	86.3	None
6+25-9+50	Beach	0.175	5.21	0.21	33.5	33.6	14	451	84.7	None
6+25-9+50	Beach	<0.028	10.8	0.48	24.3	37	31.6	650	139	Surface
6+25-9+50	Beach	1.8	2.0	1.5	229	38.5	109	NA	698	Surface
6+25-9+50	Beach	9.3	2.8	<1.1	277	54.4	108	NA	479	Subsurface
6+25-9+50	Beach	2.8	6.8	<1	252	36.0	67.5	NA	345	Surface
6+25-9+50	Northern alcove	0.77	4.67	0.49	159	35.9	26.8	1,750	15	None
6+25-9+50	Northern alcove	0.46	5.37	0.43	55	31.6	18.8	917	104	None
6+25-9+50	Toe	0.072	1.87	<0.216	<13.9	7.91	12.8	293	79	None
12+50-15+50	Toe	<0.020	2.28	<0.149	<9.1	7.39	3.9	148	46.8	None

Notes:
NA = not applicable
PCB = polychlorinated biphenyl

APPENDIX A

MONITORING FORMS

EVRAZ RIVERBANK SOURCE CONTROL MEASURES
INSPECTION & MAINTENANCE LOG

Property Address: Evraz Oregon Steel Mill
14400 N Rivergate Blvd
Portland, OR 972102

Inspection Date: _____ Inspection Time:_____

Inspected By: _____

Inspection Type: Routine_____ Post Maintenance Follow-up _____

Rainfall Information

Date/Time of Last Rainfall: _____ Rainfall Data Source: _____

Rainfall Total: _____

SCM Element	Problem	Yes or No?	Corrective Action	Photo No.
Berm	Standing water			
	Clogged or Damaged Irrigation Lines			
	Gullies			
	Erosion			
	Slope Slippage			
	Safety hazards			

STORMWATER SOURCE CONTROL MEASURES INSPECTION & MAINTENANCE LOG (cont.)				
SCM Element	**Problem**	**Yes or No?**	**Corrective Action**	**Photo No.**
Bank	Rock Armor Sloughing			
	Exposed Geotextile Fabric			
	Gullies			
	Erosion			
	Slope Slippage			
	Safety hazards			
Upper Beach	Beach Substrate Marker Stakes visible			
	Erosion			
	Safety hazards			

Note: Monitoring and Maintenance will follow procedures provided in the Long Term Maintenance and Monitoring Plan for Riverbank Source Control Measures for the Evraz Facility.

EVRAZ RIVERBANK SOURCE CONTROL MEASURES
INSPECTION & MAINTENANCE LOG

Property Address: Evraz Oregon Steel Mill
14400 N Rivergate Blvd
Portland, OR 972102

Inspection Date: _____ Inspection Time:_____

Inspected By: _____

Inspection Type: Routine_____ Post Maintenance Follow-up _____

Rainfall Information

Date/Time of Last Rainfall: _____ Rainfall Data Source: _____

Rainfall Total: _____

SCM Element	Problem	Yes or No?	Corrective Action	Photo No.
East Landfill - North Side	Exposed Orange Indicator Fabric			
	Gullies			
	Erosion			
	Slope Slippage			
	Vegetation Bare Spots			
	Safety hazards			
Mold Basement	Exposed Orange Indicator Fabric			
	Ruts in Gravel Cap			
	Safety hazards			

Note: Monitoring and Maintenance will follow procedures provided in the Long Term Maintenance and Monitoring Plan for Riverbank Source Control Measures for the Evraz Facility.

Evraz Oregon Steel Riverbank Stabilization

Photo Log

Monitoring Year: _____

Date: _____

Investigator(s):

Photo Location	Photo Number	Orientation	Description	Camera

Evraz Oregon Steel Riverbank Stabilization
Native Vegetation Monitoring Plan
Years 1-4

Monitoring Year: _____
Date: _____
Investigator(s): _____

Transect #

Percent Survival of Planted Trees/Shrubs (10' x 10' Plots)		Plot 1			Plot 2			Plot 3			Plot 4			Plot 5			Plot 6		
		# Planted (2015-2016)	# Living Plants	% Survival	# Planted (2015-2016)	# Living Plants	% Survival	# Planted (2015-2016)	# Living Plants	% Survival	# Planted (2015-2016)	# Living Plants	% Survival	# Planted (2015-2016)	# Living Plants	% Survival	# Planted (2015-2016)	# Living Plants	% Survival
Trees																			
Abies grandis	Grand Fir																		
Acer macrophyllum	Bigleaf Maple																		
Alnus rubra	Red Alder																		
Crataegus douglassii	Black Hawthorne																		
Fraxinus latifolia	Oregon Ash																		
Populus balsamifera ssp. Triocarpa	Black Cottonwood																		
Pseudotsuga menziesii	Douglas Fir																		
Shrubs																			
Cornus sericea var. stolonifera	Red-osier Dogwood																		
Corylus cornuta	Beaked Hazelnut																		
Holodiscus discolor	Oceanspray																		
Mahonia nervosa	Oregon Grape																		
Oemleria cerasiformis	Indian Plum																		
Philadelphis lewisii	Mock Orange																		
Ribes sanguineum	Red Flowering Currant																		
Rosa nutkana	Nootka Rose																		
Rubus parviflora	Thimbleberry																		
Sabucus racemosa	Red Elderberry																		
Salix hookeriana	Hooker's Willow																		
Salix lucida ssp. Lasiandra	Pacific Willow																		
Salix stichensis	Sitka Willow																		
Symphoricarpus albus	Snowberry																		
Total Number Native Trees/Shrubs																			
Total Percent Cover Native Herbaceous Species																			
Percent Cover Noxious/Invasive Herbaceous and Shrub Species																			

Evraz Oregon Steel Riverbank Stabilization
Native Vegetation Monitoring Plan
Years 5, 7, and 10

Monitoring Year: _____
Date: _____
Investigator(s): _____

Transect #

Percent Survival of Planted Trees/Shrubs (10' x 10' Plots)		Plot 1			Plot 2			Plot 3			Plot 4			Plot 5			Plot 6		
		# Planted (2015-2016)	# Living Plants	% Survival	# Planted (2015-2016)	# Living Plants	% Survival	# Planted (2015-2016)	# Living Plants	% Survival	# Planted (2015-2016)	# Living Plants	% Survival	# Planted (2015-2016)	# Living Plants	% Survival	# Planted (2015-2016)	# Living Plants	% Survival
Trees																			
Abies grandis	Grand Fir																		
Acer macrophyllum	Bigleaf Maple																		
Alnus rubra	Red Alder																		
Crataegus douglassii	Black Hawthorne																		
Fraxinus latifolia	Oregon Ash																		
Populus balsamifera ssp. Triocarpa	Black Cottonwood																		
Pseudotsuga menziesii	Douglas Fir																		
Shrubs																			
Cornus sericea var. stolonifera	Red-osier Dogwood																		
Corylus cornuta	Beaked Hazelnut																		
Holodiscus discolor	Oceanspray																		
Mahonia nervosa	Oregon Grape																		
Oemleria cerasiformis	Indian Plum																		
Philadelphis lewisii	Mock Orange																		
Ribes sanguineum	Red Flowering Currant																		
Rosa nutkana	Nootka Rose																		
Rubus parviflora	Thimbleberry																		
Sabucus racemosa	Red Elderberry																		
Salix hookeriana	Hooker's Willow																		
Salix lucida ssp. Lasiandra	Pacific Willow																		
Salix stichensis	Sitka Willow																		
Symphoricarpus albus	Snowberry																		
Total Number Native Trees/Shrubs																			
Total Percent Cover Native Herbaceous Species																			
Percent Cover Noxious/Invasive Herbaceous and Shrub Species																			

Evraz Oregon Steel Riverbank Stabilization
Native Vegetation Monitoring Plan
Years 5, 7, and 10

Monitoring Year: _____
Date: _____
Investigator(s): _____

Transect #

Percent Cover		**Plot 1**		**Plot 2**		**Plot 3**		**Plot 4**		**Plot 5**		**Plot 6**	
		# Plants	**% Cover**	**# Plants**	**% Cover**	**# Plants**	**% Cover**	**# Plants**	**% Cover**	**# Plants**	**% Cover**	**# Plants**	**% Cover**
Trees - 30' Diamter Plot													
Abies grandis	Grand Fir												
Acer macrophyllum	Bigleaf Maple												
Alnus rubra	Red Alder												
Crataegus douglassii	Black Hawthorne												
Fraxinus latifolia	Oregon Ash												
Populus balsamifera ssp. Triocarpa	Black Cottonwood												
Pseudotsuga menziesii	Douglas Fir												
Shrubs - 10' x 10' Plot													
Cornus sericea var. stolonifera	Red-osier Dogwood												
Corylus cornuta	Beaked Hazelnut												
Holodiscus discolor	Oceanspray												
Mahonia nervosa	Oregon Grape												
Oemleria cerasiformis	Indian Plum												
Philadelphis lewisii	Mock Orange												
Ribes sanguineum	Red Flowering Currant												
Rosa nutkana	Nootka Rose												
Rubus parviflora	Thimbleberry												
Sabucus racemosa	Red Elderberry												
Salix hookeriana	Hooker's Willow												
Salix lucida ssp. Lasiandra	Pacific Willow												
Salix stichensis	Sitka Willow												
Symphoricarpus albus	Snowberry												

APPENDIX B

SEISMIC DESIGN REPORT

TO:	Linda Baker, Integral Consulting
FROM:	Mike Byers, P.E. – CRETE Consulting Inc.
PROJECT:	EVRAZ Oregon Steel Rivergate Facility
SUBJECT:	Technical Memorandum – Stability Analysis Riverbank Source Control Measure
DATE:	November 4, 2014
CC:	File

EVRAZ Oregon Steel (EOS) is implementing a source control measure (SCM) to remove and stabilize contaminants in the riverbank at its Rivergate property in Portland, Oregon. This memorandum describes the results of stability calculation to support of the SCM. Attachment 1 contains a selection from the current design set that shows the configuration and location of the Riverbank SCM including the primary components of the design. Attachment 2 contains the details stability calculations and Attachment 3 contains the calculations to determine berm stabilization measures necessary for long term berm stability. The study modeled various slope conditions that include the following conditions:

- Construction condition: where the slope excavation has been completed and no backfill has been placed
- Long-term static and seismic conditions: with the groundwater and river water levels at elevation 9.6
- Long-term static and seismic conditions: with the groundwater and river water levels at OHW (elevation 16.6)
- Long-term static and seismic conditions: with the groundwater and river water levels at the 100-yr flood elevation of 27.5.

The two-dimension, pseudo-static slope stability modeling program SLIDE 6.0 developed by RocScience was utilized to determine the critical factors of safety for the slope conditions and configurations. The program allows input of reinforcement layers and seismic loading and performs a search for the most critical failure surface given a set of input parameters.

Input Parameters

Input parameters for the stability study included the following:

- Slope Geometry – Attachment 1 shows the design profile of the stabilization as well as the cross section details along the riverbank. A section in the center of the riverbank

area (station 15+00) was selected as the most critical section since this location contains the highest berm section.

- Material Properties – Attachment 2 contains the detailed development of material properties for analyses of the slope. The basic soil units included the berm material, soil slag fill, dredged fill/shallow native soil, rock armor, crushed rock cushioning layer, filtration geotextile, and backfilled berm or imported material. Soil properties were developed using existing soil boring information that has been completed across the riverbank through numerous soil exploration programs. Soil/slag fill properties were also developed based on the exposed material physical characteristics where this soil unit is standing vertical over the entire riverbank project area.

- Excavation slope geometry – It was assumed that the excavation geometry would be the only the excavation required to shape the slope as indicated on Attachment 1 to facilitate stabilization backfill.

- Groundwater conditions – Three different groundwater conditions were utilized in the stability study to model the variable groundwater conditions expected to occur at the site. The low water conditions utilized both river water and groundwater elevation at 9.6 ft. The high water conditions utilized both river water and groundwater elevations at the 100-year flood elevation of 27.5. And an intermediate river water and groundwater level at the ordinary high water elevation of 16.6 was utilized. For the purposes of the stability study, the groundwater elevation was assumed to be flat across the model area.

- Seismic loading – Seismic loading input parameters consisted of a pseudo-static horizontal parameter that was taken as ½ of the peak ground acceleration (PGA) at the site for an earthquake level that represented a 10 percent probability of exceedance in 50 years (corresponds to a recurrence interval of about 500 years). The PGA was developed by using established USGS Seismic Hazard Maps as detailed in a recent geotechnical study completed by others on the site for a new pipe rolling mill. The new pipe rolling mill project was completed by Evraz Oregon Steel in 2005. The PGA was determined to be 0.19g, so the pseudo-static input parameter was 0.10.

- Reinforcement Geotextile – Berm backfill required to be placed after the rock armor was installed on the riverbank required an increase in internal stability to result in an overall stable section. This internal strength increase was accomplished by adding reinforcement layers of geotextile to the berm backfill which resulted in augmenting the backfill strength to result in an overall stable slope. Reinforcement geotextile strength and backfill parameters were developed by performing a parametric study of the backfill by varying the spacing, length and strength of reinforcement until a suitable set of reinforcement parameters was developed. The final design includes a reinforcement geotextile fabric or grid placed every 2.5 feet within the berm backfill. The tensile

strength of the geotextile/geogrid is required to be 100 pounds per inch (ASTM D-4595). Attachment 3 contains the detailed calculation.

- Erosion protection of berm surface – The backfilled berm surface will require protection from erosion until the planned vegetation becomes established. This slope face will be stabilized using a heavy jute matting that is anchored in place. Attachment 3 contains the detailed calculation for erosion protection.

Results

Table 1 presents the stability study results. The results are presented using a minimum factor of safety. The factor of safety is the ratio of the forces resisting (soil strength, reinforcement) over the forces driving (soil weight, earthquake loading) slope movement. A calculated factor of safety of 1.0 indicates that the forces just balance each other and slope movement is likely.

Table 1 – Minimum Factor of Safety for a given Slope Condition

Run No.	Condition Evaluated	Min FS
1	Static conditions, groundwater and river water at elevation 9.6. Reinforced berm backfill	1.36
2	Static conditions, groundwater and river water at elevation 16.6. Reinforced berm backfill	1.36
3	Static conditions, groundwater and river water at elevation 27.5. Reinforced berm backfill	1.59
4	Seismic conditions, groundwater and river water at elevation 9.6. Reinforced berm backfill	1.10
5	Seismic conditions, groundwater and river water at elevation 16.6. Reinforced berm backfill	1.10
6	Seismic conditions, groundwater and river water at elevation 27.5. Reinforced berm backfill	1.28
7	During construction – full excavated condition	1.11

Full output is provided in Attachment 2.

Discussion

The calculations indicate that the minimum factor of safety for the long term static conditions is 1.36 at lower water levels. Rising river water and groundwater levels result in a slightly higher factor of safety.

The addition of a seismic force results in minimum calculated factors of safety of 1.1. As the factor of safety becomes lower and approaches 1.0, in all likelihood some slope movement will occur during a seismic event that approaches or exceeds the design level seismic event. Potential slope movement as a result of a seismic event (not considering potential influences of underlying soil liquefaction) is anticipated to be in the form of small amounts of downhill creep of the stabilization components. Since these components are relatively flexible given the small anticipated movements, this movement will probably not affect the function of the stabilization and may not need to be repaired. Deeper seated soil liquefaction cold result in scattered strength loss in layers within the dredged fill and native deposits that underlie the site and extend upland. The extent to which these layers are inter-connected will dictate whether liquefaction is in a large enough area to result in significant movement of the riverbank slope. The results could range from small amounts of settlement up to relatively large movements (lateral spreading) in excess of several feet. The potential hazards associated with the deeper seated soil liquefaction are generally not affected by the riverbank stabilization since it is relatively shallow.

The minimum factor of safety calculated for the fully excavated condition during construction was 1.10. The anticipated excavation slope is steepest where cut into the soil slag fill soil and for a short distance into the underlying dredge fill/native soil deposits. Field observations and boring information suggests that the soil slag fill is a relatively competent unit since it is observed to stand vertical for up to about 10 feet on the site now. The underlying dredge fill/native layer should be observed carefully during construction to make sure it acts as anticipated. Groundwater is anticipated to be at the base of the excavation. Significant groundwater encountered above the base of the planned excavation area may result in localized instability if not drained properly.

Field conditions should be observed during construction to verify that conditions are as described in this calculation. If conditions vary, this calculation should be revisited to make sure that the results and conclusions remain valid.

Attachment 1 – Select design drawing sheets

Attachment 2 – Slope Stability Calculation

Attachment 3 – Berm Stabilization Calculation

Attachment 1 – Select design drawing sheets

EOSM STORE ST'K.	VENDOR NUMBER	BILL OF MATERIAL				DRWG. NO. D-85780	
NUMBER	NAME / NUMBER	PART NO.	PC. NO.	NO. REQ'D.	DESCRIPTION	COMMENTS	WEIGHT

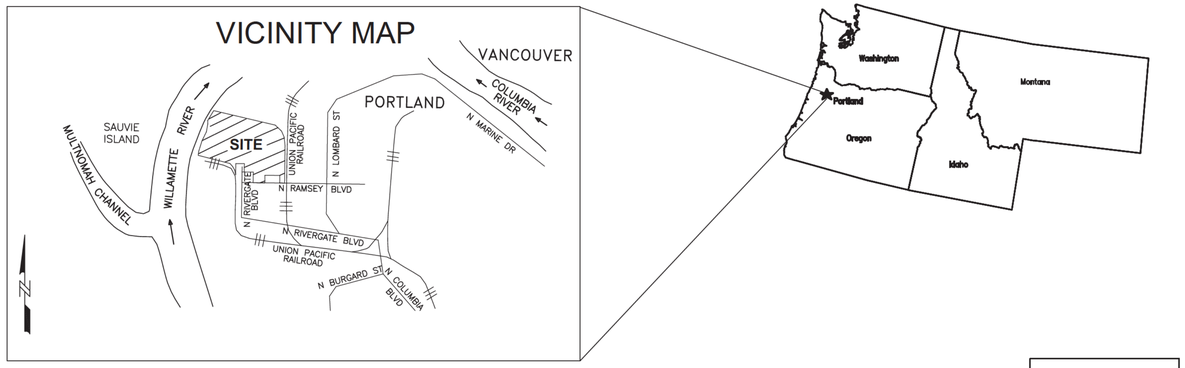
RIVERBANK DESIGN

EVRAZ PORTLAND RIVERGATE FACILITY
PORTLAND, OREGON

DRAWING	DRAWING TITLE DRAWING
D-85780	COVER SHEET AND INDEX TO SHEETS
D-85781	LEGEND AND GENERAL NOTES SHEET 1 OF 2
D-85782	LEGEND AND GENERAL NOTES SHEET 2 OF 2
D-85783	HAUL ROUTE AND STAGING AREAS
D-85784	SURVEY CONTROL INFORMATION
D-85785	EXISTING CONDITIONS SHEET 1 OF 3
D-85786	EXISTING CONDITIONS SHEET 2 OF 3
D-85787	EXISTING CONDITIONS SHEET 3 OF 3
D-85788	SITE PHOTOGRAPHS
D-85789	SITE PREPARATION AND EROSION AND SEDIMENT CONTROL COVER SHEET 1 OF 2
D-85790	SITE PREPARATION AND EROSION AND SEDIMENT CONTROL COVER SHEET 2 OF 2
D-85791	SITE PREPARATION AND EROSION AND SEDIMENT CONTROL SHEET 1 OF 3

DRAWING	DRAWING TITLE DRAWING
D-85792	SITE PREPARATION AND EROSION AND SEDIMENT CONTROL SHEET 2 OF 3
D-85793	SITE PREPARATION AND EROSION AND SEDIMENT CONTROL SHEET 3 OF 3
D-85794	SITE PREPARATION AND EROSION AND SEDIMENT CONTROL DETAILS SHEET 1 OF 2
D-85795	SITE PREPARATION AND EROSION AND SEDIMENT CONTROL DETAILS SHEET 2 OF 2
D-85796	EXCAVATION PLAN AND CROSS SECTIONS SHEET 1 OF 4
D-85797	EXCAVATION PLAN AND CROSS SECTIONS SHEET 2 OF 4
D-85798	EXCAVATION PLAN AND CROSS SECTIONS SHEET 3 OF 4
D-85799	EXCAVATION PLAN AND CROSS SECTIONS SHEET 4 OF 4
D-85800	EXCAVATION AND BACKFILL DETAILS SHEET 1 OF 3
D-85801	EXCAVATION AND BACKFILL DETAILS SHEET 2 OF 3
D-85802	EXCAVATION AND BACKFILL DETAILS SHEET 3 OF 3
D-85803	BACKFILL PLAN AND CROSS SECTIONS SHEET 1 OF 4

DRAWING	DRAWING TITLE DRAWING
D-85804	BACKFILL PLAN AND CROSS SECTIONS SHEET 2 OF 4
D-85805	BACKFILL PLAN AND CROSS SECTIONS SHEET 3 OF 4
D-85806	BACKFILL PLAN AND CROSS SECTIONS SHEET 4 OF 4
D-85807	PLANTING PLAN SHEET 1 OF 3
D-85808	PLANTING PLAN SHEET 2 OF 3
D-85809	PLANTING PLAN SHEET 3 OF 3
D-85810	PLANTING DETAILS SHEET 1 OF 2
D-85811	PLANTING DETAILS SHEET 2 OF 2
D-85812	PLANTING SPECIFICATIONS SHEET 1 OF 3
D-85813	PLANTING SPECIFICATIONS SHEET 2 OF 3
D-85814	PLANTING SPECIFICATIONS SHEET 3 OF 3



NOT TO SCALE

90% AGENCY DRAFT SET
NOT FOR CONSTRUCTION

NOTES:
1. AS-BUILT CONDITIONS DEPICTED ON THESE DRAWINGS ARE APPROXIMATE IN LOCATION. CHANGES FROM THE CONSTRUCTION DRAWINGS WERE PROVIDED BY HAND WRITTEN MARK-UPS.
2. AS-BUILT GRADES SHOWN ARE BASED ON DESIGN CONTOURS NOT SURVEY DATA.

PREPARED BY:

CRETE CONSULTING, INC.
108 S. WASHINGTON ST.
SUITE 300
SEATTLE, WA 98104

integral consulting inc.
319 SW WASHINGTON ST.
SUITE 1150
PORTLAND, OR 97204

EVRAZ
PRELIMINARY
for your review
and comment

NO.	DATE	REVISION	BY	APPR.

CAD FILE LOCATION: P:\Projects\C1144_StRives_Evraz\CAD\Production Drawings\Riverbank_Design\D-85780_Cover_Sheet_Index.dwg

EVRAZ
14400 N.E. RIVERGATE BLVD.
PORTLAND, OREGON 97203
PH. (503) 240-5240

EVRAZ
PORTLAND, OREGON

DO NOT SCALE DRAWING

FINISH SYMBOLS: P POLISH; G GRIND; F FINE; O ORDINARY; R ROUGH; M MACHINE CUT

TOLERANCES (UNLESS OTHERWISE SPECIFIED)

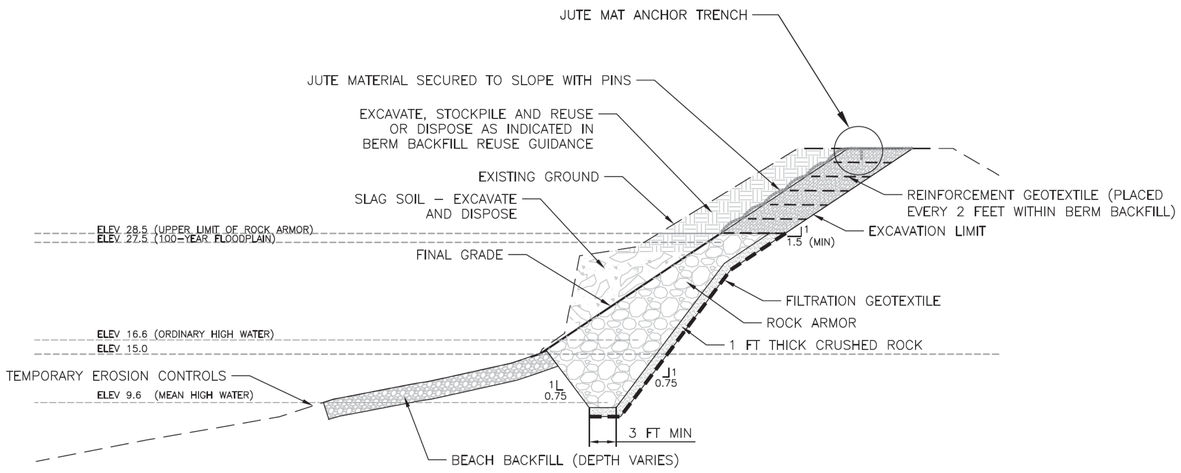
FRACTIONAL DIM.	± 1/16
DECIMAL 1 PLACE DIM.	± .100
DECIMAL 2 PLACE DIM.	± .015
DECIMAL 3 PLACE DIM.	± .005
ANGLES	± 0°-30'

SCALE
DATE 11/19/2014
DRWN. EB
CHKD.-APPR. JS/MB
CODE

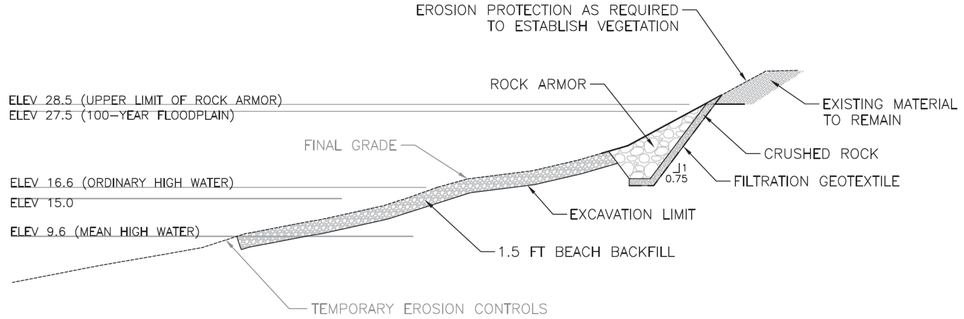
COVER SHEET AND INDEX TO SHEETS

DRWG. NO. D-85780
REV.

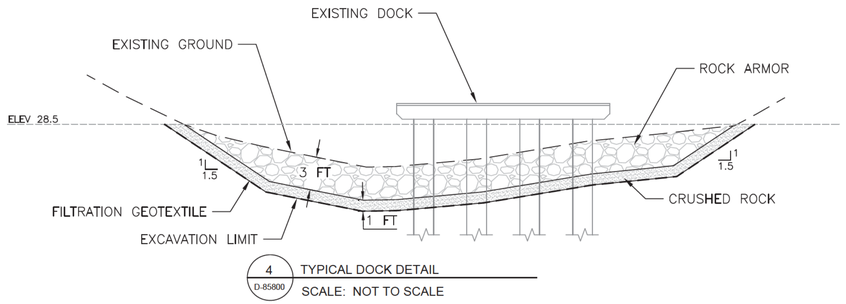
EOSM STORE ST'K.	VENDOR NUMBER	BILL OF MATERIAL				DRWG. NO. D-85800	
NUMBER	NAME / NUMBER	PART NO.	PC. NO.	NO. REQ'D.	DESCRIPTION	COMMENTS	WEIGHT



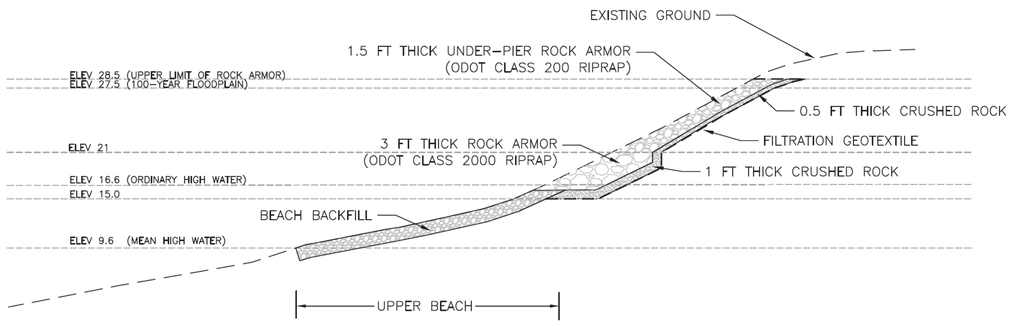
1 / D-85800 TYPICAL RIVERBANK DETAIL
SCALE: NOT TO SCALE



2 / D-85800 NORTHERN ALCOVE DETAIL
SCALE: NOT TO SCALE



4 / D-85800 TYPICAL DOCK DETAIL
SCALE: NOT TO SCALE



5 / D-85800 TYPICAL DOCK DETAIL
SCALE: NOT TO SCALE

EVRAZ
PRELIMINARY
for your review and comment

90% AGENCY DRAFT SET
NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	APPR.

CAD FILE LOCATION: P:\Projects\C1144_StRives_Evraz\CAD\Production Drawings\Riverbank_Design\D-85800_D-85802_Details_S1_3.dwg

PREPARED BY:

CRETE CONSULTING, INC.
108 S. WASHINGTON ST.
SUITE 300
SEATTLE, WA 98104

integral consulting inc.
319 SW WASHINGTON ST.
SUITE 1150
PORTLAND, OR 97204

FINISH SYMBOLS: POLISH, GRIND, FINE, ORDINARY, ROUGH, MACHINE CUT

DO NOT SCALE DRAWING

TOLERANCES (UNLESS OTHERWISE SPECIFIED)

FRACTIONAL DIM.	± 1/16
DECIMAL 1 PLACE DIM.	± .100
DECIMAL 2 PLACE DIM.	± .015
DECIMAL 3 PLACE DIM.	± .005
ANGLES	± 0°-30'

EVRAZ
14400 N.E. RIVERGATE BLVD.
PORTLAND, OREGON 97203
PH. (503) 240-5240

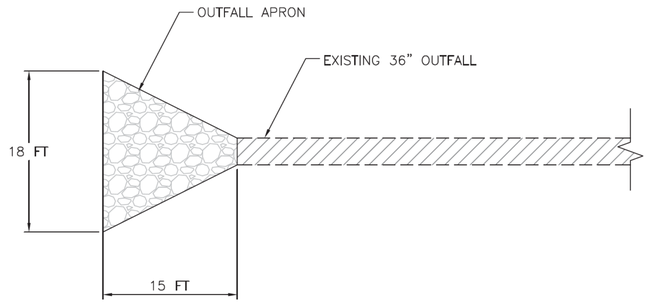
EVRAZ
PORTLAND, OREGON

SCALE: VARIES
DATE: 11/19/2014
DRWN.: EB
CHKD.-APPR.: JS/MB

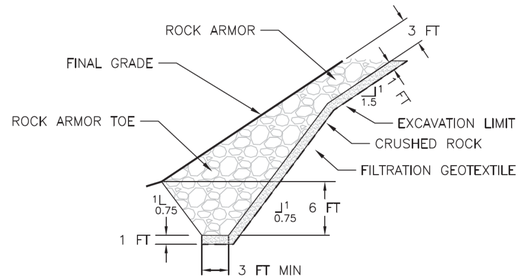
EXCAVATION AND BACKFILL DETAILS SHEET 1 OF 3

CODE:
DRWG. NO.: D-85800
REV.:

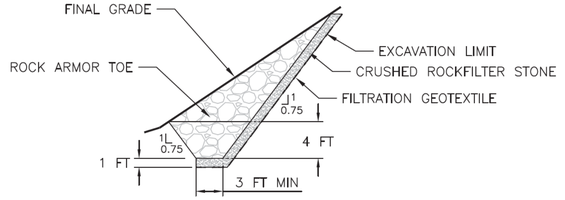
EOSM STORE ST'K. NUMBER	VENDOR NUMBER NAME NUMBER	BILL OF MATERIAL				DRWG. NO. D-85801
		PART NO.	PC. NO.	NO. REQ'D.	DESCRIPTION	COMMENTS / WEIGHT



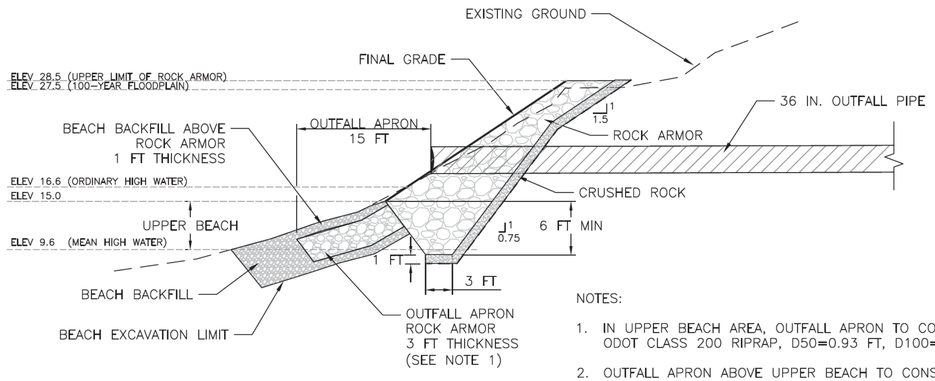
1 / D-85804 OUTFALL SCOUR PROTECTION APRON PLAN - OUTFALLS 001 AND 003
SCALE: NOT TO SCALE



2 / D-85796 TYPICAL ROCK ARMOR TOE AND RIVERBANK DESIGN
SCALE: NOT TO SCALE



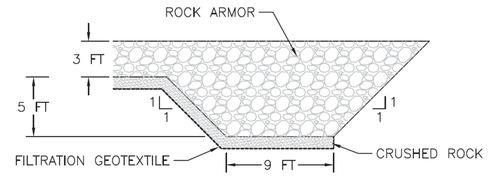
3 / D-85796 TYPICAL ROCK ARMOR TOE AND RIVERBANK DESIGN IN NORTHERN ALCOVE
SCALE: NOT TO SCALE



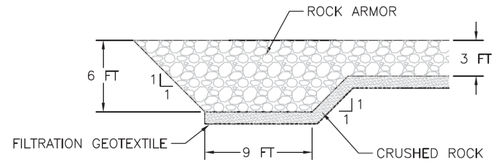
NOTES:

1. IN UPPER BEACH AREA, OUTFALL APRON TO CONSIST OF ODOT CLASS 200 RIPRAP, D50=0.93 FT, D100=1.32 FT.
2. OUTFALL APRON ABOVE UPPER BEACH TO CONSIST OF TYPICAL ROCK ARMOR (ODOT CLASS 2000 RIPRAP)

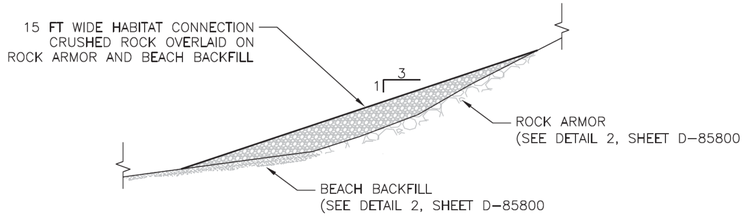
4 / D-85804 TYPICAL OUTFALL SCOUR PROTECTION APRON SECTION
SCALE: NOT TO SCALE



5 / D-85799 TYPICAL ROCK ARMOR TOE - UPSTREAM FLANK
SCALE: NOT TO SCALE



6 / D-85796 TYPICAL ROCK ARMOR TOE - DOWNSTREAM FLANK
SCALE: NOT TO SCALE



7 / D-85803 HABITAT CONNECTION IN NORTHERN ALCOVE
SCALE: NOT TO SCALE

EVRAZ
PRELIMINARY
for your review and comment

90% AGENCY DRAFT SET
NOT FOR CONSTRUCTION

NO.	DATE	REVISION	BY	APPR.

CAD FILE LOCATION: P:\Projects\C1144_StRives_Evraz\CAD\Production Drawings\Riverbank_Design\D-85800_D-85802_Details_S1_3.dwg

PREPARED BY:

CRETE CONSULTING, INC.
108 S. WASHINGTON ST.
SUITE 300
SEATTLE, WA 98104

integral consulting inc.
319 SW WASHINGTON ST.
SUITE 1150
PORTLAND, OR 97204

FINISH SYMBOLS: POLISH, GRIND, FINE, ORDINARY, ROUGH, MACHINE CUT

DO NOT SCALE DRAWING

TOLERANCES (UNLESS OTHERWISE SPECIFIED)

FRACTIONAL DIM.	± 1/16
DECIMAL 1 PLACE DIM.	± .100
DECIMAL 2 PLACE DIM.	± .015
DECIMAL 3 PLACE DIM.	± .005
ANGLES	± 0°-30'

EVRAZ
14400 N.E. RIVERGATE BLVD.
PORTLAND, OREGON 97203
PH. (503) 240-5240

EVRAZ PORTLAND, OREGON

SCALE: VARIES
DATE: 11/19/2014
DRWN.: EB
CHKD.-APPR.: JS/MB

EXCAVATION AND BACKFILL DETAILS SHEET 2 OF 3

CODE:
DRWG. NO.: D-85801
REV.:

EOSM STORE ST'K.	VENDOR NUMBER	BILL OF MATERIAL				DRWG. NO. D-85802	
NUMBER	NAME / NUMBER	PART NO.	PC. NO.	NO. REQ'D.	DESCRIPTION	COMMENTS	WEIGHT

EXCAVATION NOTES:

1. DURING EXCAVATION ACTIVITIES IF THE CONTRACTOR ENCOUNTERS EVIDENCE OF CONTAMINATION THE FOLLOWING STEPS SHALL BE TAKEN:
   A. SEEPING FREE-PRODUCT IN EXCAVATION -
      - IMMEDIATELY NOTIFY THE ENGINEER.
      - USE BMPS (SORBENT SOCKS, BOOMS) TO IMMEDIATELY STABILIZE THE AREA TO PREVENT PRODUCT MIGRATION TO THE RIVER.
      - DOCUMENT THE LOCATION AND SUBMIT TO THE ENGINEER.
      - EVALUATE IF A POTENTIAL SOURCE IS APPARENT IN THE EXCAVATION. AN EXAMPLE WOULD BE AN ISOLATED LEAKING CONTAINER. IF SO, REMOVE THE SOURCE AND SEPARATE THE REMOVED MATERIAL FOR APPROPRIATE CHARACTERIZATION FOR DISPOSAL. BACKFILL THE AREA USING ONSITE MATERIAL, CONSTRUCT THE STABILIZATION MEASURES AS DESIGNED.
      - IF A POTENTIAL SOURCE IS NOT APPARENT, DETERMINE A TEMPORARY STABILIZATION APPROACH TO BE APPROVED BY THE ENGINEER AND BASED ON THE GEOMETRY AND CHARACTERISTICS OF THE SEEP AND COMPLETE THE STABILIZATION IN THE AREA. CHARACTERIZATION AND REMEDIATION OF THE NEW AREA WILL OCCUR AT A LATER DATE.
   B. SOIL STAINING THAT COULD RESULT IN SHEEN UPON WETTING -
      - IMMEDIATELY NOTIFY THE ENGINEER.
      - USE BMPS TO IMMEDIATELY STABILIZE THE AREA TO PREVENT PRODUCT MIGRATION TO THE RIVER.
      - DOCUMENT THE LOCATION AND SUBMIT TO THE ENGINEER.
      - IF A POTENTIAL SOURCE FOR THE STAINING IS APPARENT, REMOVE IT AND THE STAINED SOIL. BACKFILL WITH ONSITE MATERIAL AND COMPLETE THE RIVERBANK STABILIZATION MEASURES AS DESIGNED.
      - IF NO APPARENT SOURCE IS PRESENT, COVER THE AREA WITH AN ORGANOCLAY OR ACTIVATED CARBON INFUSED GEOTEXTILE FABRIC THAT WILL ACT TO MAINTAIN STABILIZATION OF THE SOIL BEHIND THE MAT AND HELP ADDRESS SEEPS THAT MAY BE PRODUCED. THE ENGINEER SHALL APPROVE MATERIAL SPECIFICATIONS AND PLACEMENT PROCEDURES.

2. NO ADDITIONAL COMPENSATION WILL BE MADE TO THE CONTRACTOR FOR DEALING WITH OBSTRUCTIONS. IF OBSTRUCTIONS ARE ENCOUNTERED DURING EXCAVATION, THE CONTRACTOR SHALL COMPLETE THE FOLLOWING STEPS:
   A. NOTIFY THE ENGINEER.
   B. IF THE EXPOSED OBSTRUCTION IS TOO LARGE TO REMOVE, EITHER CHIP OUT THE PORTION THAT EXTENDS INTO THE BANK STABILIZATION, OR PROVIDE FOR THE STABILIZATION TO BE COMPLETED AROUND THE OBSTRUCTION. THIS DETERMINATION WILL BE MADE WITH THE ENGINEER.
   C. IF THE OBSTRUCTION CAN BE REMOVED WITHOUT AFFECTING THE REMAINING BANK STABILITY, REMOVE THE OBSTRUCTION AND BACKFILL THE VOID USING ONSITE SOIL. CONSTRUCT THE STABILIZATION OVER THE AREA AS DESIGNED.

3. IF OTHER SUBSTANCES THAT ARE THOUGHT TO BE HAZARDOUS ARE ENCOUNTERED DURING EXCAVATION, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER FOR DIRECTIONS ON HOW TO PROCEED.

BACKFILL NOTES:

1. SUBMIT TEST RESULTS PRIOR TO IMPORTING ANY BACKFILL MATERIAL TO THE SITE, IN ACCORDANCE WITH:
   A. SIEVE ANALYSES AND COMPARISON TO THE REQUIRED SPECIFICATIONS
   B. MOISTURE DENSITY CURVE FOR GRAVEL BORROW IN ACCORDANCE WITH ASTM D1557 (MODIFIED PROCTOR)
   C. IMPORTED BACKFILL MATERIAL SHALL BE NATURALLY OCCURRING OR NATURAL MATERIAL BLENDED TO ACHIEVE GRADATION REQUIREMENTS LISTED HEREIN. THE BACKFILL SHALL NOT CONTAIN RECYCLED MATERIAL OF ANY TYPE AND SHALL NOT BE FROM AN INDUSTRIAL SITE.
   D. COMPLIANCE WITH ANALYTICAL TESTING SPECIFICATIONS SHOWN ON THE PLANS.

2. BACKFILLING IS REQUIRED TO OCCUR ON A RELATIVELY STEEP SLOPE AND SPECIAL CONSTRUCTION METHODS MAY BE REQUIRED TO COMPLETE THE BACKFILLING AS DESIGNED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONSTRUCTING THE BACKFILL AS DESIGNED (INCLUDING THE LINES AND GRADES OF ALL SLOPE COMPONENTS) AND SHALL CONSIDER THAT A SLOWER, SEQUENTIAL SLOPE CONSTRUCTION MAY BE NECESSARY TO MAINTAIN STABILITY DURING BACKFILLING. THE SEQUENTIAL CONSTRUCTION MAY INCLUDE PLACING LIFTS OF CRUSHED ROCK AND ROCK ARMOR AGAINST THE FILTRATION GEOTEXTILE AS THE SLOPE IS BUILT UP IN SEGMENTS TO RESULT IN A CONSTRUCTED SLOPE AS DESIGNED. NO COMPENSATION WILL BE PAID BEYOND THE BID AMOUNT FOR CONSTRUCTING THE SLOPE AS DESIGNED.

3. REINFORCEMENT GEOTEXTILE SHALL BE PLACED WITHIN ALL BERM BACKFILL AS SHOWN ON THE DRAWINGS. THE FIRST REINFORCEMENT GEOTEXTILE LAYER SHALL BE PLACED DIRECTLY OVER THE TOP OF THE ROCK ARMOR. SUBSEQUENT LAYERS SHALL BE PLACED IN HORIZONTAL LAYERS EVERY 2 FEET (VERTICAL) WITHIN THE BERM BACKFILL TO RESULT IN A UNIFORM REINFORCED BERM BACKFILL.

4. PLACE REINFORCEMENT GEOTEXTILE AS REQUIRED (LOCATION AND ELEVATION):
   A. THE FIRST SECTION OF GEOTEXTILE SHOULD BE PLACED OVER THE TOP OF THE ROCK ARMOR TO KEEP BERM BACKFILL FROM ENTERING INTO THE ROCK.
   B. GEOTEXTILE LAYERS SHALL BE PLACED HORIZONTAL WITH 1 FT MINIMUM OVERLAP BETWEEN LAYERS, OR SPLICED ACCORDING TO MANUFACTURING RECOMMENDATIONS.
   C. BACKFILL SHALL BE PLACED IN 8 INCH MINIMUM LIFT THICKNESS AND COMPACTED TO 92% ASTM D-1557 MINIMUM COMPACTION.
   D. GEOTEXTILE LAYERS SHALL BE PLACED EVERY 2 FT WITHIN THE BACKFILL IN HORIZONTAL LAYERS.
   E. GEOTEXTILE SHALL BE LAID OUT ON A SMOOTH SURFACE AND STRETCHED SO THAT NO WRINKLES EXIST IN THE MATERIAL.
   F. BACKFILL SHALL BE PLACED IN A CONTROLLED MANOR SO THAT EQUIPMENT IS NEVER CLOSER THAN 6INCHES TO THE GEOTEXTILE LAYER.

5. THE CONTRACTOR SHALL PLACE MATERIAL USED FOR THE CONSTRUCTION OF EMBANKMENTS AND FILLS IN HORIZONTAL LAYERS UPON EARTH WHICH HAS BEEN STABILIZED OR OTHERWISE APPROVED BY THE ENGINEER FOR EMBANKMENT CONSTRUCTION.

6. FOR BERM AREAS BACKFILLED WITH APPROVED SALVAGED MATERIAL OR IMPORT MATERIAL, THE CONTRACTOR SHALL CONSTRUCT EARTH EMBANKMENTS AND FILLS IN SUCCESSIVE HORIZONTAL LAYERS NOT EXCEEDING 8 INCHES IN LOOSE THICKNESS. COMPACT EACH LAYER OF THE TOP 2 FEET OF EMBANKMENT TO 92% OF ITS MAXIMUM DRY DENSITY, AS DETERMINED BY TEST METHOD ASTM D-1557 (MODIFIED PROCTOR).

7. CARRY THE LAYERS UP FULL WIDTH FROM THE BOTTOM OF THE EMBANKMENT OR FILL AREA. COMPACT THE SLOPES OF ALL EMBANKMENTS TO THE REQUIRED DENSITY AS PART OF THE EMBANKMENT COMPACTION WORK. THE BACKFILL SHALL BE COMPACTED WITH MODERN, EFFICIENT COMPACTING UNITS SATISFACTORY TO THE ENGINEER.

8. PRIOR TO THE PLACEMENT OF FILTRATION GEOTEXTILE FOR RIPRAP SLOPE, THE BANK SHALL BE GRADED AND DRESSED TO ELIMINATE ANY IRREGULARITIES.

9. PLACE RIPRAP BEDDING MATERIAL (CRUSHED ROCK) IN A MANNER TO AVOID DISPLACING THE UNDERLYING MATERIAL OR PLACING UNDUE IMPACT FORCE ON UNDERLYING MATERIALS AND SUPPORTING SUBSOIL. PLACE BEDDING IN A MANNER TO PRODUCE A RESULTANT GRADED MASS OF STONE WITH MINIMUM VOIDS. PLACEMENT OF RIPRAP BEDDING SHALL BEGIN AT THE BOTTOM OF THE SLOPE AND PROCEED UPWARD.

10. PLACE RIPRAP IN A MANNER TO AVOID DISPLACING THE UNDERLYING MATERIAL OR PLACING UNDUE IMPACT FORCE ON UNDERLYING MATERIALS AND SUPPORTING SUBSOIL. PLACE RIPRAP IN A MANNER TO PRODUCE A RESULTANT GRADED MASS OF STONE WITH MINIMUM VOIDS. PLACEMENT OF RIPRAP SHALL BEGIN AT THE BOTTOM OF THE SLOPE AND PROCEED UPWARD. RIPRAP SHALL BE PLACED USING AN EXCAVATOR EQUIPPED WITH THUMP AND FIRMLY TAMPED IN PLACE WITH BUCKET TO ENSURE INTERLOCKING OF STONES.

11. FIELD TESTS TO DETERMINE IN-PLACE COMPLIANCE WITH REQUIRED DENSITIES AS SPECIFIED, SHALL BE PERFORMED IN ACCORDANCE WITH ASTM D1557, D2167, OR D6938.

MATERIAL SPECIFICATIONS:

1. FILTRATION GEOTEXTILE SHALL MEET THE STANDARDS LISTED IN ODOT 02320-2 FOR WOVEN GEOTEXTILE. SHALL BE PLACED PER ODOT 00350.41 FOR RIPRAP GEOTEXTILE. REINFORCEMENT GEOTEXTILE SHALL CONSIST OF US 2600 OR SG 150 FROM US FABRIC OR AN EQUIVALENT APPROVED BY THE ENGINEER.

2. TYPICAL ROCK ARMOR SHALL CONSIST OF ODOT CLASS 2000 RIPRAP. UNDER-PIER AND OUTFALL APRON ROCK ARMOR SHALL CONSIST OF ODOT CLASS 200 RIPRAP, AS SPECIFIED ON THE PLANS. ALL ROCK ARMOR SHALL MEET THE GRADATION AND TESTING REQUIREMENTS LISTED IN ODOT 00390.11. ROCK ARMOR SHALL BE FREE OF ROCK FINES, SOIL, ORGANIC MATERIAL, OR OTHER EXTRANEOUS MATERIAL. THE GRADING OF THE RIPRAP SHALL BE DETERMINED BY THE ENGINEER BY VISUAL INSPECTION OF THE LOAD BEFORE IT IS MACHINE PLACED, OR, IF SO ORDERED BY THE ENGINEER, BY DUMPING INDIVIDUAL LOADS ON A FLAT SURFACE AND SORTING AND MEASURING THE INDIVIDUAL ROCKS CONTAINED IN THE LOAD.

3. CRUSHED ROCK SHALL COMPLY WITH ODOT SECTION 02630.10, SIZE 1-1/2 TO 0 INCH MATERIAL.

4. BEACH BACKFILL SHALL BE CLEAN, NATURALLY OCCURRING WATER ROUNDED GRAVEL MATERIAL. BEACH BACKFILL SHALL HAVE A WELL-GRADED DISTRIBUTION OF COBBLE/GRAVEL SIZES AND CONFORM TO THE FOLLOWING SPECIFICATIONS:

SIEVE SIZE/NUMBER	SIEVE SIZE (mm)	% PASSING
12"	305	95-100
8"	203	70-80
4"	102	45-55
2"	51	30-40
1"	25	20-30
NO. 4	4.8	10-15

5. CHEMICAL ACCEPTANCE CRITERIA FOR ALL IMPORTED AGGREGATE AND SOIL WITH THE EXCEPTION OF ROCK ARMOR SHALL MEET THE REQUIREMENTS INCLUDED IN THE DESIGN REPORT RIVERBANK SOURCE CONTROL MEASURE. IMPORT MATERIAL SHALL MEET TIER 1 CRITERIA AND BE COMMERCIALLY AVAILABLE WITHIN 30 MILES OF THE SITE. IF TIER 1 CRITERION CANNOT BE MET BY COMMERCIALLY AVAILABLE IMPORT SOURCES WITHIN 30 MILES OF THE SITE, IMPORT MATERIAL WITH CONCENTRATIONS UP TO THE TIER 2 IMPORT CRITERIA AND COMMERCIALLY AVAILABLE WITHIN A 30 MILE RADIUS OF THE SITE WILL BE ACCEPTED ON A CASE-BY-CASE BASIS. CONTRACTOR SHALL SUBMIT CHEMICAL TEST RESULTS MEETING TIER 2 CRITERION TO THE ENGINEER FOR APPROVAL. IF IMPORT MATERIAL COMMERCIALLY AVAILABLE WITHIN A 30 MILE RADIUS OF THE SITE DOES NOT MEET TIER 2 CRITERIA, THE CONTRACTOR SHALL CONTACT THE ENGINEER IMMEDIATELY AND THE ENGINEER WILL DETERMINE, WITH DEQ, THE FEASIBILITY OF USING ALTERNATIVE CRITERIA. THE CONTRACTOR SHALL PROVIDE DOCUMENTATION OF THE CHEMICAL COMPOSITION OF ALL IMPORT AGGREGATE AND SOIL TO DEMONSTRATE THAT THE PROPOSED IMPORT MATERIAL MEETS THE CHEMICAL ACCEPTANCE CRITERIA. DEMONSTRATION OF CHEMICAL COMPOSITION IS REQUIRED FOR EACH TYPE AND SOURCE OF IMPORT AGGREGATE AND SOIL WITH THE EXCEPTION OF THE ROCK ARMOR. THE ENGINEER WILL APPROVE ALL IMPORT MATERIAL PRIOR TO BRINING IMPORT MATERIALS ON SITE.

6. ALL TESTING TO DEMONSTRATE COMPLIANCE WITH SPECIFICATIONS SHALL BE SUBMITTED AND APPROVED BY THE ENGINEER PRIOR TO PURCHASE OF THE MATERIAL.

EVRAZ

PRELIMINARY

for your review and comment

90% AGENCY DRAFT SET
NOT FOR CONSTRUCTION

PREPARED BY:

CRETE CONSULTING, INC.
108 S. WASHINGTON ST.
SUITE 300
SEATTLE, WA 98104

integral consulting inc.
319 SW WASHINGTON ST.
SUITE 1150
PORTLAND, OR 97204

NO.	DATE	REVISION	BY	APPR.

CAD FILE LOCATION: P:\Projects\C1144_SRRives_Evraz\CAD\Production Drawings\Riverbank_Design\D-85800_D-85802_Details_S1_3.dwg

EVRAZ
14400 N.E. RIVERGATE BLVD.
PORTLAND, OREGON 97203
PH. (503) 240-5240

FINISH SYMBOLS: POLISH, GRIND, FINE, ORDINARY, ROUGH, MACHINE CUT

DO NOT SCALE DRAWING

TOLERANCES (UNLESS OTHERWISE SPECIFIED)

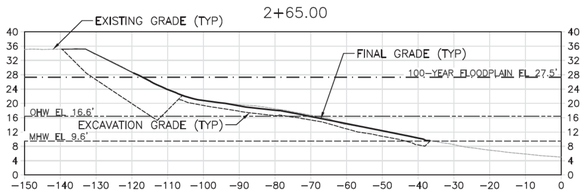
FRACTIONAL DIM.	± 1/16
DECIMAL 1 PLACE DIM.	± .100
DECIMAL 2 PLACE DIM.	± .015
DECIMAL 3 PLACE DIM.	± .005
ANGLES	± 0°-30'

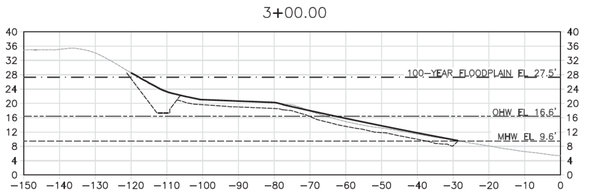
EVRAZ
PORTLAND, OREGON

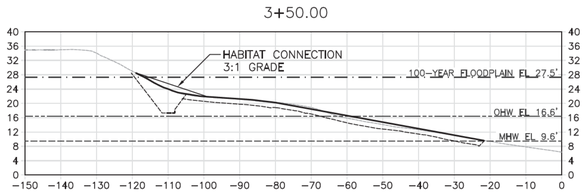
SCALE	VARIES
DATE	11/19/2014
DRWN.	EB
CHKD.-APPR.	JS/MB
CODE	
DRWG. NO.	D-85802
REV.	

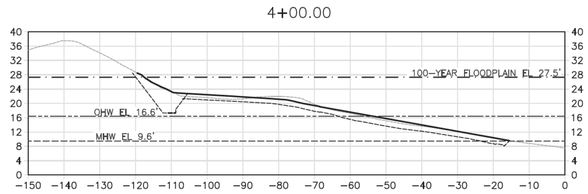
EXCAVATION AND BACKFILL DETAILS SHEET 3 OF 3

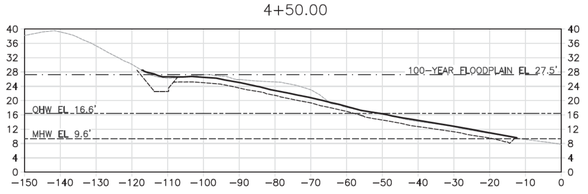
EOSM STORE ST'K.	VENDOR NUMBER	BILL OF MATERIAL				DRWG. NO. D-85803	
NUMBER	NAME / NUMBER	PART NO.	PC. NO.	NO. REQ'D.	DESCRIPTION	COMMENTS	WEIGHT

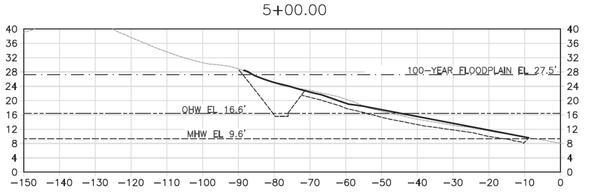


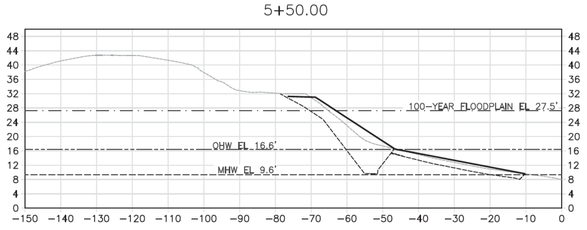


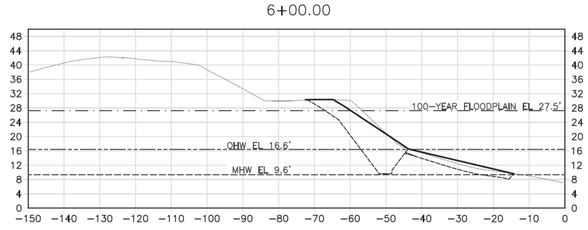


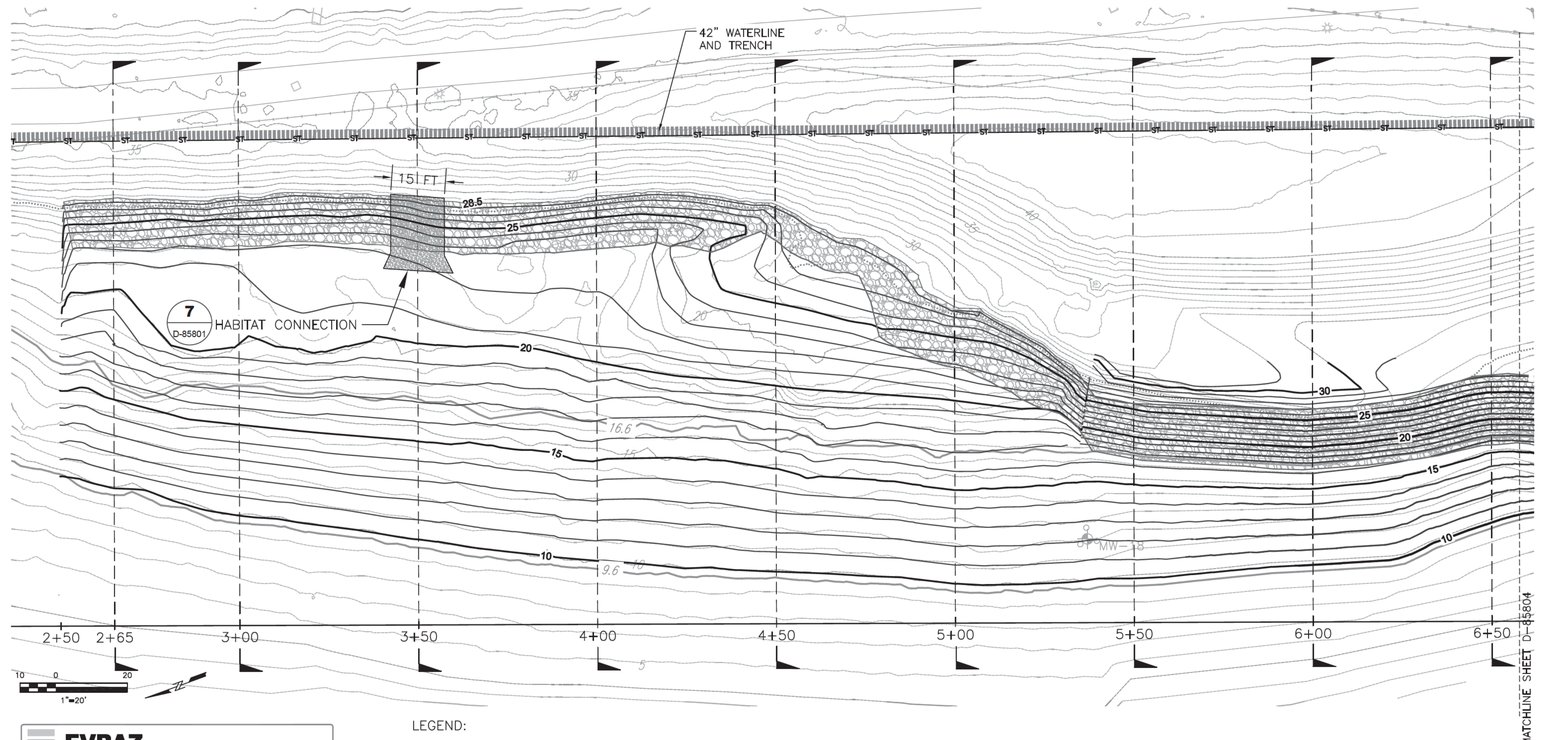


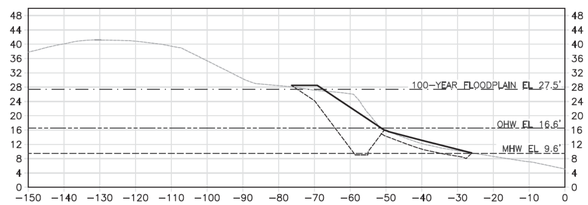












NOTES:

1. CONTOUR INTERVAL = 1 FOOT

LEGEND:

EXPOSED ROCK ARMOR PROTECTION

EVRAZ

PRELIMINARY

for your review and comment

90% AGENCY DRAFT SET
NOT FOR CONSTRUCTION

PREPARED BY:

CRETE CONSULTING, INC.
108 S. WASHINGTON ST.
SUITE 300
SEATTLE, WA 98104

integral consulting inc.
319 SW WASHINGTON ST.
SUITE 1150
PORTLAND, OR 97204

NO.	DATE	REVISION	BY	APPR.

CAD FILE LOCATION: P:\Projects\C1144_SRRives_Evraz\CAD\Production Drawings\Riverbank_Design\D-85803_D-85806_Backfill_Sections_S1_4.dwg

EVRAZ
14400 N.E. RIVERGATE BLVD.
PORTLAND, OREGON 97203
PH. (503) 240-5240

EVRAZ
PORTLAND, OREGON

FINISH SYMBOLS
125 POLISH
250 GRIND
500 FINE
1000 ORDINARY
2000 ROUGH
MACHINE CUT

DO NOT SCALE DRAWING

TOLERANCES
(UNLESS OTHERWISE SPECIFIED)

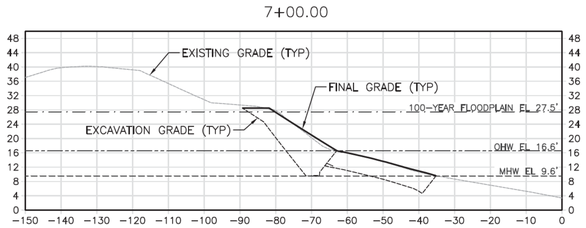
FRACTIONAL DIM.	± 1/16
DECIMAL 1 PLACE DIM.	± .100
DECIMAL 2 PLACE DIM.	± .015
DECIMAL 3 PLACE DIM.	± .005
ANGLES	± 0°-30'

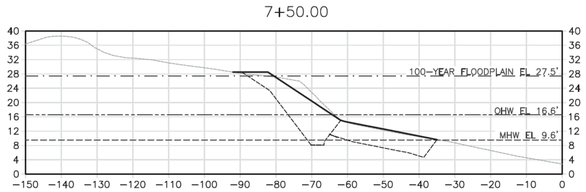
SCALE	1"=20'
DATE	11/19/2014
DRWN.	EB
CHKD.-APPR.	JS/MB
CODE	

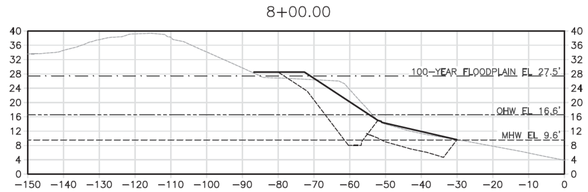
BACKFILL PLAN AND CROSS SECTIONS SHEET 1 OF 4

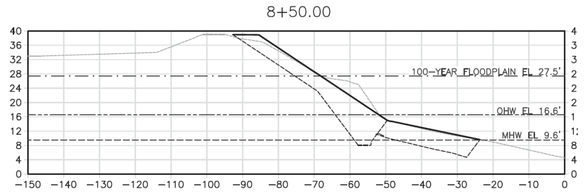
DRWG. NO. D-85803 REV.

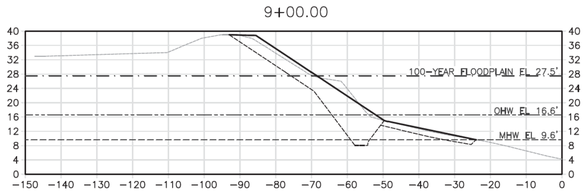
EOSM STORE ST'K.	VENDOR NUMBER	BILL OF MATERIAL				DRWG. NO. D-85804	
NUMBER	NAME / NUMBER	PART NO.	PC. NO.	NO. REQ'D.	DESCRIPTION	COMMENTS	WEIGHT

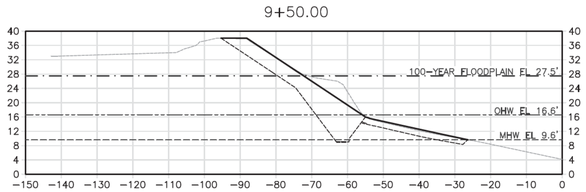


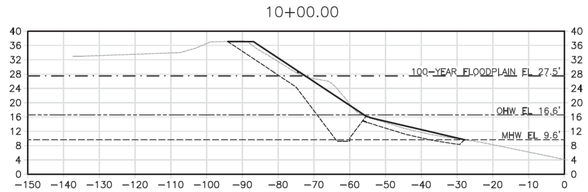


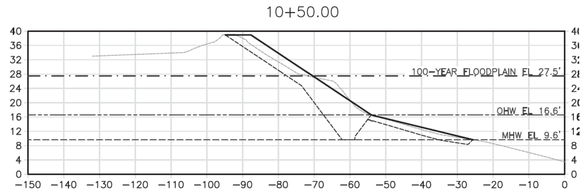


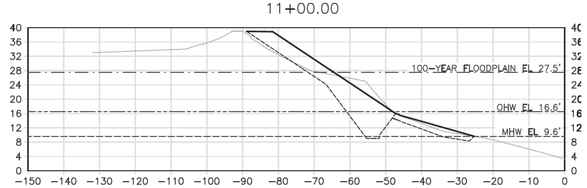


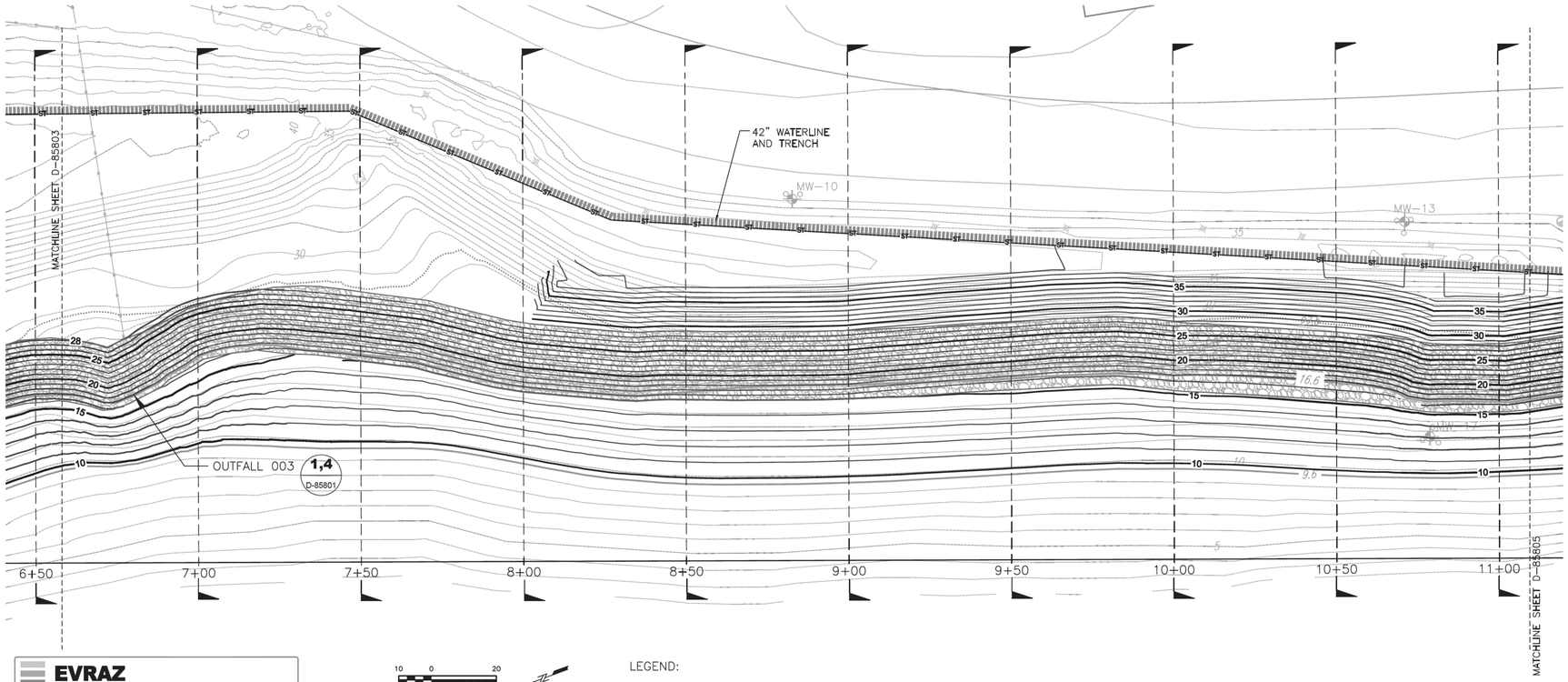












NOTES:

1. CONTOUR INTERVAL = 1 FOOT

EVRAZ

PRELIMINARY

for your review and comment

90% AGENCY DRAFT SET

NOT FOR CONSTRUCTION

10 0 20

1"=20'

LEGEND:

EXPOSED ROCK ARMOR PROTECTION

PREPARED BY:

CRETE CONSULTING, INC.
108 S. WASHINGTON ST.
SUITE 300
SEATTLE, WA 98104

integral consulting inc.
319 SW WASHINGTON ST.
SUITE 1150
PORTLAND, OR 97204

NO.	DATE	REVISION	BY	APPR.

CAD FILE LOCATION: P:\Projects\C1144_StRives_Evraz\CAD\Production Drawings\Riverbank_Design\D-85803_D-85806_Backfill_Sections_S1_4.dwg

EVRAZ
14400 N.E. RIVERGATE BLVD.
PORTLAND, OREGON 97203
PH. (503) 240-5240

FINISH SYMBOLS: POLISH, GRIND, FINE, ORDINARY, ROUGH, MACHINE CUT

DO NOT SCALE DRAWING

TOLERANCES (UNLESS OTHERWISE SPECIFIED)

FRACTIONAL DIM.	± 1/16
DECIMAL 1 PLACE DIM.	± .100
DECIMAL 2 PLACE DIM.	± .015
DECIMAL 3 PLACE DIM.	± .005
ANGLES	± 0°-30'

EVRAZ PORTLAND, OREGON

SCALE 1"=20'
DATE 11/19/2014
DRWN. EB
CHKD.-APPR. JS/MB

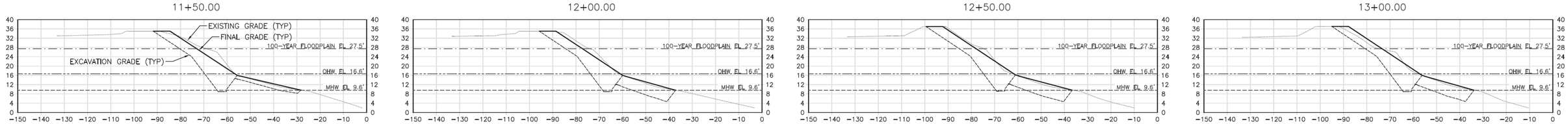
BACKFILL PLAN AND CROSS SECTIONS SHEET 2 OF 4

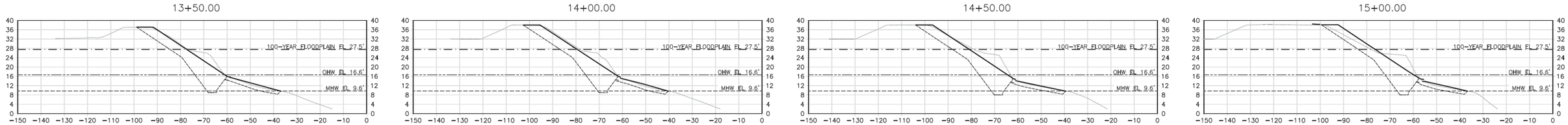
CODE

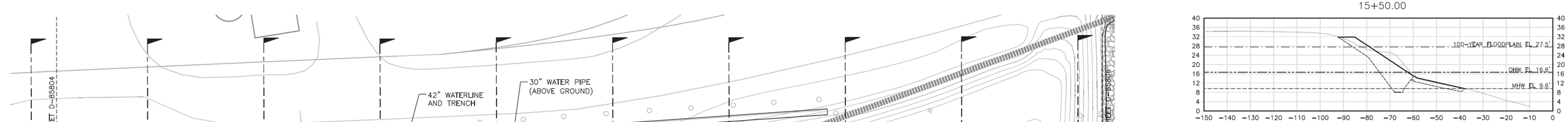
DRWG. NO. D-85804

REV.

EOSM STORE ST'K.	VENDOR NUMBER	BILL OF MATERIAL				DRWG. NO. D-85805	
NUMBER	NAME / NUMBER	PART NO.	PC. NO.	NO. REQ'D.	DESCRIPTION	COMMENTS	WEIGHT







NOTES:

1. CONTOUR INTERVAL = 1 FOOT

EVRAZ

PRELIMINARY

for your review and comment

90% AGENCY DRAFT SET

NOT FOR CONSTRUCTION

10 0 20

1"=20'

LEGEND:

EXPOSED ROCK ARMOR PROTECTION

PREPARED BY:

CRETE CONSULTING, INC.
108 S. WASHINGTON ST.
SUITE 300
SEATTLE, WA 98104

integral consulting inc.
319 SW WASHINGTON ST.
SUITE 1150
PORTLAND, OR 97204

NO.	DATE	REVISION	BY	APPR.

CAD FILE LOCATION: P:\Projects\C1144_SHRives_Evraz\CAD\Production Drawings\Riverbank_Design\D-85803_D-85806_Backfill_Sections_S1_4.dwg

EVRAZ
14400 N.E. RIVERGATE BLVD.
PORTLAND, OREGON 97203
PH. (503) 240-5240

EVRAZ
PORTLAND, OREGON

SCALE 1"=20'
DATE 11/19/2014
DRWN. EB
CHKD.-APPR. JS/MB

BACKFILL PLAN AND CROSS SECTIONS
SHEET 3 OF 4

CODE

DRWG. NO. D-85805

REV.

DO NOT SCALE DRAWING

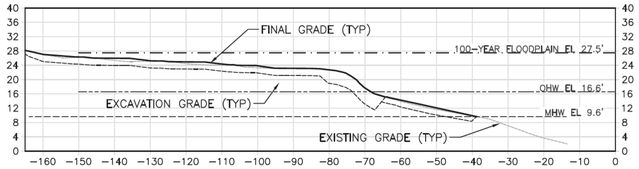
FINISH SYMBOLS: POLISH, GRIND, FINE, ORDINARY, ROUGH, MACHINE CUT

TOLERANCES (UNLESS OTHERWISE SPECIFIED)

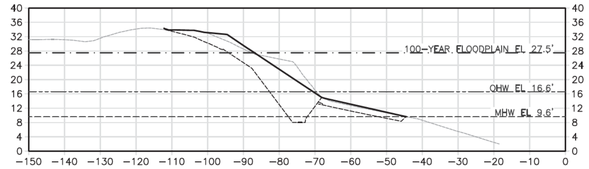
FRACTIONAL DIM.	± 1/16
DECIMAL 1 PLACE DIM.	± .100
DECIMAL 2 PLACE DIM.	± .015
DECIMAL 3 PLACE DIM.	± .005
ANGLES	± 0°-30'

EOSM STORE ST'K.	VENDOR NUMBER	BILL OF MATERIAL				DRWG. NO. D-85806	
NUMBER	NAME NUMBER	PART NO.	PC. NO.	NO. REQ'D.	DESCRIPTION	COMMENTS	WEIGHT

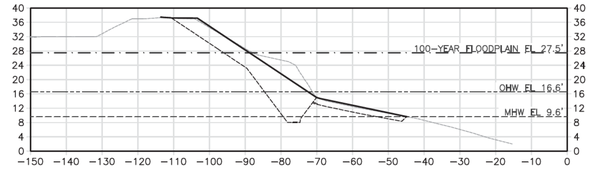
15+80.00



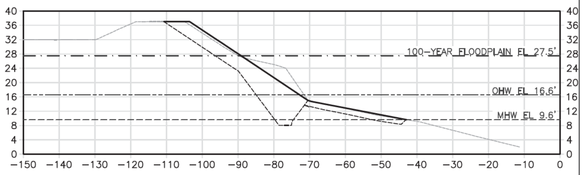
16+50.00



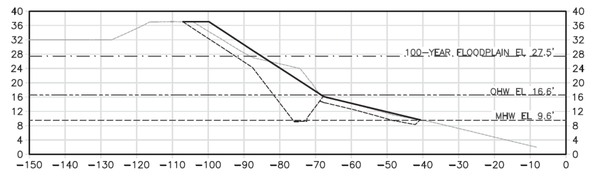
17+00.00



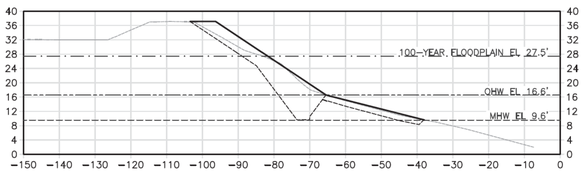
17+50.00



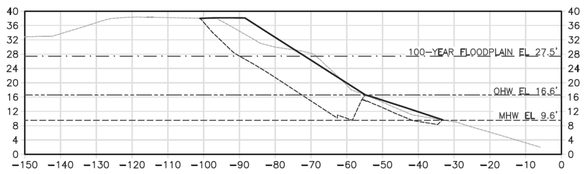
18+00.00



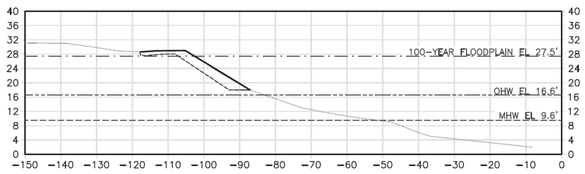
18+50.00

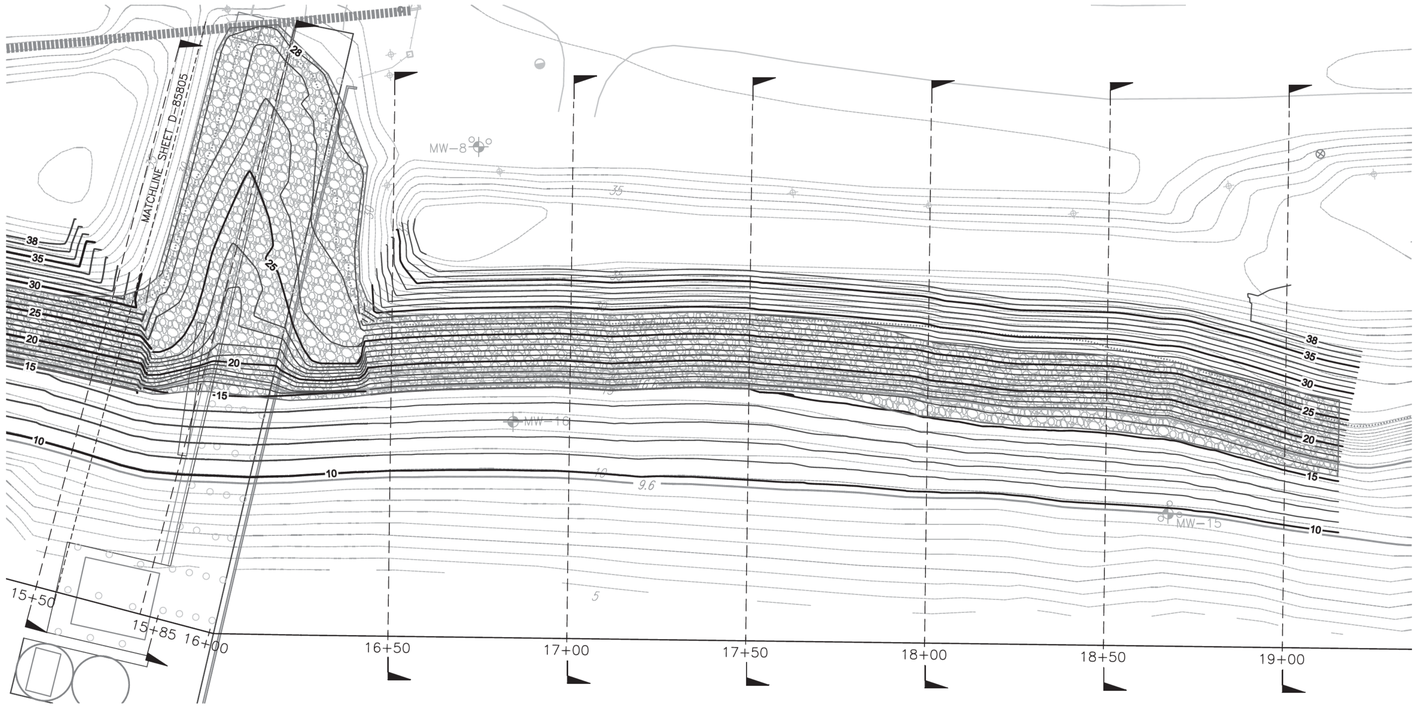


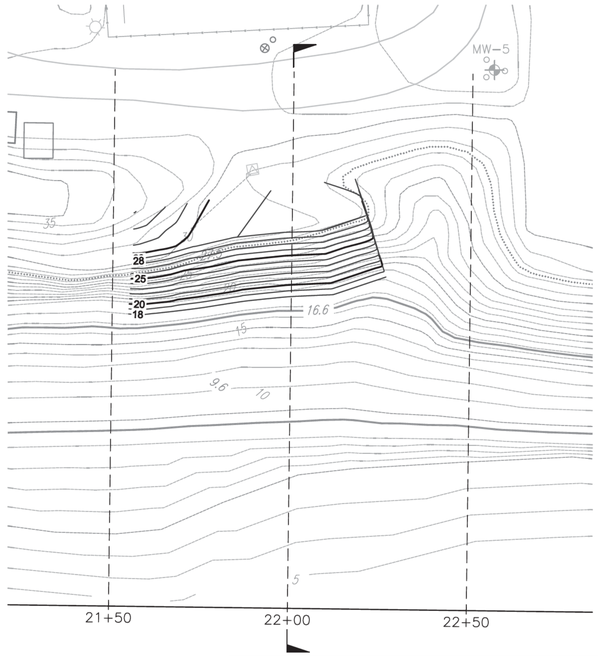
19+00.00



22+00.00







10 0 20
1"=20'

NOTES:

1. CONTOUR INTERVAL = 1 FOOT

LEGEND:

EXPOSED ROCK ARMOR PROTECTION

EVRAZ

PRELIMINARY

for your review and comment

90% AGENCY DRAFT SET

NOT FOR CONSTRUCTION

PREPARED BY:

CRETE CONSULTING, INC.
108 S. WASHINGTON ST.
SUITE 300
SEATTLE, WA 98104

integral consulting inc.
319 SW WASHINGTON ST.
SUITE 1150
PORTLAND, OR 97204

FINISH SYMBOLS: POLISH, GRIND, FINE, ORDINARY, ROUGH, MACHINE CUT

DO NOT SCALE DRAWING

TOLERANCES (UNLESS OTHERWISE SPECIFIED)

FRACTIONAL DIM.	± 1/16
DECIMAL 1 PLACE DIM.	± .100
DECIMAL 2 PLACE DIM.	± .015
DECIMAL 3 PLACE DIM.	± .005
ANGLES	± 0°-30'

NO.	DATE	REVISION	BY	APPR.

CAD FILE LOCATION: P:\Projects\C1144_StRives_Evraz\CAD\Production Drawings\Riverbank_Design\D-85803_D-85806_Backfill_Sections_S1_4.dwg

EVRAZ
11400 N.E. RIVERGATE BLVD.
PORTLAND, OREGON 97203
PH. (503) 240-5240

EVRAZ
PORTLAND, OREGON

SCALE 1"=20'
DATE 11/19/2014
DRWN. EB
CHKD.-APPR. JS/MB

BACKFILL PLAN AND CROSS SECTIONS SHEET 4 OF 4

CODE

DRWG. NO. D-85806

REV.

Attachment 2 – Slope Stability Calculation

PURPOSE: To evaluate the stability of the riverbank stabilization measures to be taken at Evraz.

GIVEN

- Most current version of drawings for the Riverbank Stabilization project.
- Subsurface explorations have been completed throughout the riverbank area over the past 20 years. Some were completed using geotechnical sampling protocol (Split Spoon sampler, conventional free fall hammer) and some were completed using a geoprobe where physical/chemical soil properties are noted, but soil density is not recorded. In addition, geotechnical studies for plant facilities have been completed over the years. While they were not necessarily focused on the riverbank, they provide a good source for information on common soil units (i.e. to soil/slag fill and the deeper dredged fill.

  The boring information is referenced in these calculations, but not attached due to the volume of information.

- 2005 Geotechnical report prepared for the new Pipe Mill which is adjacent to the riverbank. This report is ref. 3. It contains a detailed site specific seismic evaluation that was utilized, in part, to determine seismic design parameters for the Stability Study and to determine subsurface conditions.

REFERENCES

1. Soil Mechanics in Engineering Practice, Terzaghi, Peck, Mesri. 3rd Ed. J. Wiley's Sons 1996.

2. Soil Mechanics, Design Manual 7.01, Naval Facilities Eng. Command. Sept. 1986.

3. Geotechnical Investigation, Oregon Steel Mills New Pipe Mill prepared by GeoCon, January 2005.

4. SLIDE V6.0, a two-dimensional, limit equilibrium slope stability analysis program. RocScience 2014. www.rocscience.com

ATTACHMENTS

A) Set of boring logs from explorations completed on the 6th.

B) Riverbank photos taken by MB.

C) Seismic Design Reference.

D) Stability run output results

Material Properties (Attachment A for boring logs)

Berm material -

Borings that show the characteristics of the berm material include the following:

Boring	Sta	Blow ct	Description
MW-7	19+10	3/2/3 2/3/5 2/2/4 3/1/2	Fill Sand - Dk yellow brown, tr f-gravel, tr silt. moist
MW-9	14+50	3/5/7 3/2/3 2/2/2 1/2/2	silty f-sand, tr gravel, moist
MW-13	10+75	50/4" 50/4"	f sand and Silt, some f-gravel, moist discount these as values

⇒ use silty f-sand, tr. m-c sand, tr f-gravel, moist

$$SPT\ \bar{N} = \frac{5+8+6+3+12+5+4+4}{8} = 5.8$$

using figures 19.4 ÷ 19.6 of Ref 1, and Figure 7 of ref. 2.

use. $\phi = 32°$ $C = 20$ psf. (primarily a granular mtl)

$\gamma_o = 104$ pcf. $m/c = 10\%$

$\gamma_n = 114$ pcf

Soil Slag Fill

Note - this material stands vertical in most of the exposed riverbank at typical heights of 4-8' and up to 10'.

Boring	Sta	N	Blow ct	Description
MW-5	22+30	(5)	3/2/3	sandy silty Gravel, moist
			4/4/2	gravelly silty f-sand, moist
			3/2/2	
MW-7	19+10		8/8/9	Sandy, gravelly silt, moist
			10/11/36	
		(23)	5/6/8	gravelly silty f-sand, moist
			6/7/7	
MW-8	16+50		9/6/6	silty gravelly f-sand, moist
			7/6/7	
			3/4/7	
		(9)	3/3/4	
			4/4/7	
			2/2/2	
			2/2/3	
MW-9	14+50		6/8/10	silty f-sand, tr-some gravel.
			10/13/13	
		(20)	10/20/23	
			5/5/7	
			4/2/2	
			1/0/1	White chalky matl.
			1/3/5	
			27/5/1	Gravel, some sand.
		(37)	17/19/22	
			37/34/30	
			18/29/11	
MW-10	8+10		6/11/10	Sandy Gravel, moist
			6/6/8	
			9/5/2	
			6/5/4	gravelly, sandy Silt, moist
		(11)	13/20/10	
			10/5/5	
			3/3/3	gravelly, silty Sand moist
			5/4/3	
			3/1/2	

Soil Slag fill (cont'd.)

Boring	Sta	$\bar{N}$	Blow Cts	Description
MW-13	10+75		20/24/26	gravelly sand, moist, tr silt.
			18/21/24	
			11/7/7	
			6/4/4	
			18/20/23	
		(23)	14/8/6	
			8/10/10	
			7/7/8	
			5/6/6	
			5/6/7	
			10/10/12	

On average, soil slag fill soil is medium dense to dense, silty, gravelly, fine - coarse sand, moist. It has some cohesion as indicated by vertical stability using Ref 1 & 2.

$\bar{N}$ = 20 γ_s = 110 pcf.

ϕ = 38°-40° use 36° M/C = 10% This material is observed to remain stand vertical on the riverbank up to 8-10 feet

c = γ_m = 121 pcf

→ See page 5.5 for analyses of S/S properties

Dredged fill / shallow native soil to -10

Boring	Sta	$\bar{N}$	Blow Cts	Description
MW-5	22+30		2/2/3	f-sand, tr silt, wet. tr f-gravel.
			4/4/4	
			1/2/1	
			3/2/2	
			2/1/2	
			1/2/3	
			2/3/4	
			2/3/5	
		(6)	2/3/4	
			2/2/4	
			3/3/2	
			4/4/5	
			3/4/4	
			4/3/4	
			3/2/2	

Further analyses of soil properties for input into stability analyses.

Photos of the riverbank (Attachment B) taken by MB show that the soil/slag fill soil stands vertically along the entire riverbank. The height of the vertical section varies, but is nearly always 6-8 ft tall, or perhaps even taller in places. This soil has a cohesion component as well as the frictional component. The variable nature of the soil (gravel to silt sizes) make sampling and laboratory testing nearly impossible. So soil properties will be based on blow counts, and observations of the vertical face evident along the entire riverbank.

Blow counts and soil composition suggests a friction angle between 36°-40°:

Using Ref 3, volume 7.2 page 62., for a combined cohesive & frictional material the free standing height can be calculated by:

$$Z_0 = \frac{2C}{\gamma} \tan\left(45 + \frac{\phi}{2}\right)$$

Z_0 = height in feet of free face
C = cohesion in psf
γ = unit wt in pcf.
ϕ = friction angle

Solve for $C = \frac{Z_0 \gamma}{2\left(\tan\left(45 + \frac{\phi}{2}\right)\right)}$

for $Z = 6$ ft, $\phi = 36$ $\gamma = 121$ pcf

$$C = \frac{(6\text{ ft})(121\text{ lbs/ft}^3)}{2\ \tan\left(45 + \frac{36}{2}\right)} = 185 \text{ psf}$$

⇒ use $\phi = 36°$, $C = 140$ psf, $\gamma = 121$ pcf

Dredge fill (cont'd)

Boring	Sta	N	Blow Ct	description
MW-7	19+10		2/1/1	f-sand, tr f-gravel moist to wet
			1/0/1	
			1/2/2	
			2/3/3	
			3/3/4	
			2/2/5	
		(6)	2/6/7	
			3/2/5	
			3/4/4	
			3/3/3	
			3/3/4	
			2/2/3	
			3/2/3	
			2/2/4	
			1/3/3	
MW-8	16+50		2/2/2	f-sand, tr silt, tr f-gravel Moist → wet
			3/7/5	
			5/3/4	
		(5.4)	2/4/4	
			2/2/3	
			1/1/2	
			2/2/2	
			2/3/2	
			1/1/2	
MW-9	14+50		2/1/2	f-sand, tr silt, tr f-gravel Moist to wet
			2/2/1	
		(3)	1/2/1	
			2/2/2	
			1/2/1	
			1/1/1	
MW-11	2+00		4/3/2	Silty f-sand
			2/1/1	
			4/5/7	
			4/4/4	
			3/2/3	
		(5.7)	3/3/2	
			3/4/4	
			2/1/1	
			2/2/2	
			2/3/3	
			4/4/5	

For dredge fill, primarily granular, f-sand, to f-gravel, varying amts of silt from trace to some.

SPT $\bar{N}$ = 6 γ_t = 102 pcf.

ϕ = 31°-32° M/c = 10%

c = 0 γ_n = 112 pcf

Back fill material

Rock Armor -

max size 36" average size 18-20" angular.

It will be a graded mtl that is a CW

ϕ = 44° c = 0 γ = 135 pcf.

crushed rock v. thin layer over geotextile

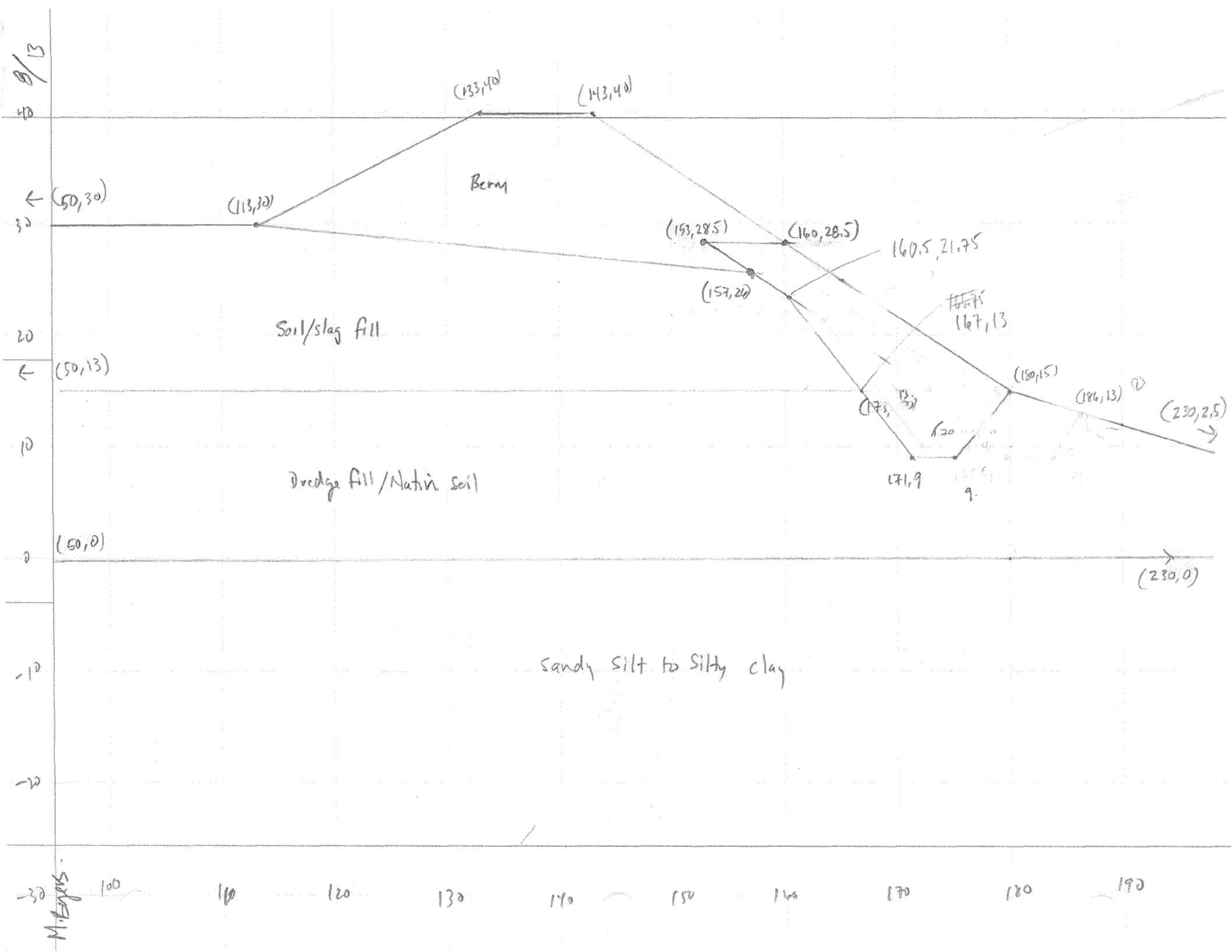
ϕ = 42° c = 0 γ = 130 pcf

geotextile layer used to stabilize S/S fill modeled as a line w ϕ = 35° c = 0 δ = 120.

geotextile reinforcement layers for berm backfill.

Woven polypropylene w/ wide width tensile strength minimum 100 lbs/in @ 5% strain - similar to US 2600 - see Attachment ___

DEVELOP CROSS SECTION.


9/13
40
30
20
10
0
-10
-20
-30
(133,40)
(143,40)
Berm
(50,30)
(113,30)
(153,28.5)
(160,28.5)
160.5, 21.75
(157,20)
167,13
Soil/slag fill
(50,13)
(180,15)
(186,13)
(230,2.5)
(173,
171,9
9.
Dredge fill/Natiη soil
(50,0)
(230,0)
Sandy silt to Silty clay
100
110
120
130
140
150
160
170
180
190
M.Bays

Stability Analyses

The two-dimensional, limit equilibrium slope stability analyses software SLIDE V1.6.0 from roc science was used for the analyses. www.rocscience.com. This program allows use of geotextile reinforcements as well as all other options in modern slope stability analyses programs. It performs a search for critical slip surfaces and calculates the factor of safety as the total resisting forces divided by the total driving forces. (Ref 4)

The cross section at the highest berm crest elevation was used for the analyses since it will be the most critical since it has the highest driving forces.

The steps taken include:

A) develop model input - Slope geometry, soil parameters, groundwater levels.

B) Determine seismic parameters - see following

C) Perform analyses on base case scenario - long term configuration with the groundwater level @ elev. 96.

D) Determine reinforcement geotextile configuration in order to make backfilled berm stable - See berm stability calculations. This was determined by inputting reinforcement layers within the berm backfill to result in a stable backfill.

E) Run a number of different stability models to model different seismic conditions, different water table levels and the conditions during construction.

Seismic Design Parameters

The riverbank stabilization components were evaluated for stability against a contingency level earthquake. The contingency level event (CLE) represents an earthquake with a 10% probability of exceedance in 50 years (i.e., 475-year return period). During a CLE, water front facilities may suffer significant damage that would impair operations and major repair work would likely be required, but no catastrophic failure would develop.

This approach of designing to a CLE is consistent with direction provided by Oregon DOT in an early design meeting on the project held on 7/29/2014.

Maps provided by the USGS (Attachment C) provide an estimated peak bedrock horizontal acceleration in the vicinity of the site of 0.19g for a 500 year return period event. This is from the USGS "National Seismic Hazard Mapping Project". Ref 3 provides an analyses completed on the site by GeoCon with the parameters.

In accordance with widely accepted analysis methods, a value equal to one half of the peak acceleration was used in the pseudo-static stability analyses

$$\Rightarrow \quad \frac{0.19}{2} = 0.10\,g = \text{pseudo-static design parameter}$$

Discussion of deeper Seismic Issues

Reference 3 (Geotechnical Evaluation for New Pipe Mill) describes the potential on the site for liquefaction of soil and lateral spreading potential. The report states:

> "Based on the results of our analyses, liquefaction at the site is possible within lenses between the depths of approximately 20 to 35 feet. . . . The results of the analyses indicate settlement of 1 to 2 inches may occur due to design level earthquake loading."

And for lateral spreading at the pipe mill site (approximately 200 ft from the river)

> "The presence of liquefiable lenses provides the potential for lateral spreading at the site. The lateral spread analyses was completed using the procedure developed by Bartlett and Youd (2002). The results of the analyses indicate minor lateral spreading of one to two inches may occur due to the design level earthquake loading."

The study completed for the new pipe mill about 200 feet from the river indicates about 2 inches of dynamic settlement due to liquefaction and up to 2 inches of lateral ground movement due to lateral spreading.

The soil layers that are problematic and subject to liquefaction at the pipe mill site (20 to 35 feet deep) are also present below the riverbank site.

This means that soil liquefaction at depth would likely occur to some degree for the CLE and it would likely result in some amount of settlement of the river bank and some amount of lateral movement of the river bank. The ground settlement amount at the riverbank would be similar to settlement predicted at the pipe mill, but the lateral spread amount is expected to be higher at the riverbank when compared to a site that is 200 feet inland from the riverbank.

The riverbank stabilization components are relatively shallow when compared to susceptible liquefiable soils at depths of 20-35 feet and they do not address these deeper seismic issues. It should be expected that a seismic event will result dynamic settlement and lateral ground movement toward the river.

Summary:

- The design level event corresponds to a 475 year return event with a peak ground acceleration of 0.19g.
- Pseudo-static stability analyses of the stabilization components themselves indicate a factor of safety greater than 1.0
- The riverbank stabilization components do not modify the risk of a seismic event resulting in deep soil liquefaction and ground movement that could result from such an event.

RESULTS

	Condition Evaluated	Min. FS	Comments
1.	Static, WL@ EL 9.0. reinforced berm backfill	1.36	
2.	Static, WL@ OHW reinforced berm backfill	1.36	
3.	Static, WL @ 100 yr flood, reinforced berm backfill	1.59	
4.	Seismic, WL@ EL 9 reinforced berm backfill	1.10	
5.	Seismic, WL @ OHW reinforced berm backfill	1.10	
6.	Seismic, WL@ 100 yr flood, reinforced berm backfill	1.28	
7.	During Construction - full excavated condition	1.11	

CONSIDERATIONS

Seismic - The factors of safety that were calculated for the seismic event were 1.1, just over 1.0. This means that in all likelihood, there will be some amount of slope movement during a seismic event that approaches and exceeds the design event. When considered exclusively (without any potential influences of deeper liquefaction) this movement is anticipated to be in the form of relatively small amounts of down hill creep of the rock armor. Since the rock armor and the underlying stabilization components are relatively flexible, this down hill creep probably will not impact the functions of the stabilizations and may not even need to be repaired.

Deeper seated soil liquefaction could result in scattered strength loss in layers within the dredged fill/native flood deposits that underlie the site. The extent to which these layers are interconnected will dictate whether liquefaction is in a large enough area to result in significant movement of the riverbank slope. The result could range from very little, if any, slope movement or deformation, up to slope movement and deformation in excess of several feet.

Short Term - The calculated factor of safety during construction is just over 1.1. Field observations and subsurface information developed on the site suggests that the soil/slag fill layer is relatively competent and that it stands vertical for heights up to 10 feet in places across the site. Dredged fill/native deposits are anticipated to be encountered within the bottom of the excavation area. This layer may be problematic if significant ground water is encountered within the layer. Observations should be made during construction to verify that conditions are as described herein. If conditions vary, this calculation should be revisited to make sure that the results and conclusions remain valid.

General

Observations should be made during construction to verify that conditions are as described in this calculation. If conditions vary, this calculation should be revisited to make sure that the results and conclusions remain valid.

ATTACHMENT A

BORING LOGS

Sta 2700

top of bank - outside NW corner of W landfill

EX™

Project No: 8601526.002.1008

Project: Oregon Steel Mills

Client: Oregon Steel Mills

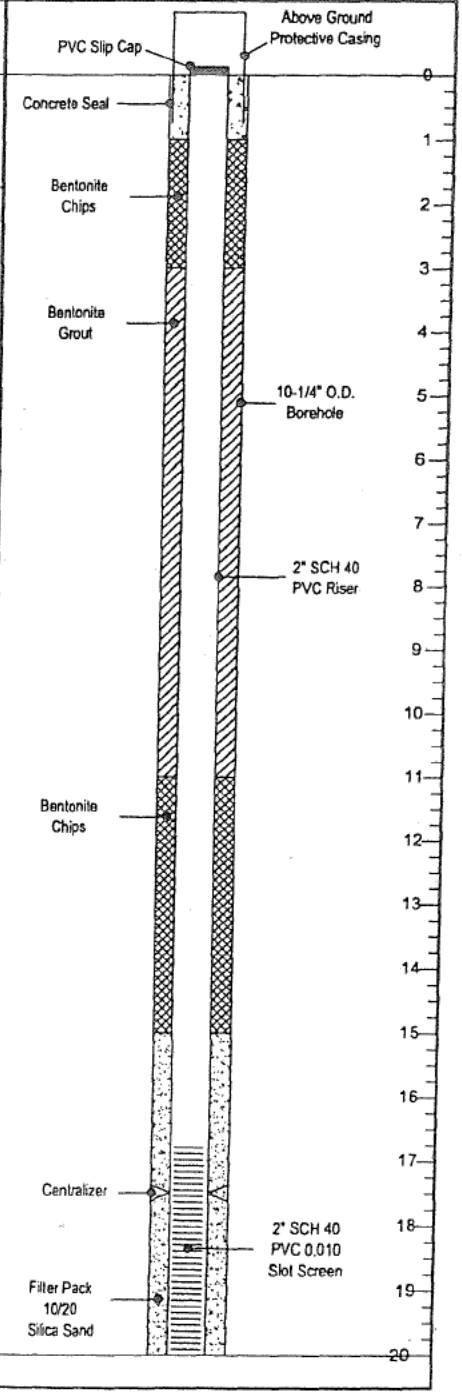
Location: Portland, OR

Monitoring Well: MW-11

Ground surface: Gravel

Geologist: E. Dodak, L. McWilliams

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION
0							
1		--	1%	3 3 1		GW	Fine to coarse GRAVEL (slag), very dark gray (10YR 3/1), slightly moist.
2		0.9	65%	4 3 2		SM	Silty very fine to fine SAND, yellow-brown (10YR 5/4), 15-25% silt, slightly moist to dry.
3							
4		0.4	70%	2 1 1			As above w/ trace organics (roots), slightly micaceous.
5	SO02-067	0.6	75%	4 5 7			Increased silt content 5.3-5.5' BGS. Color change to yellow-brown (10YR 5/4) below 5.5' BGS.
6							As above w/ decreased silt content, mostly fine sand.
7		1.3	100%	4 4 4			Increased silt content 7.1-7.3' BGS only.
8		1.1	80%	3 2 3			Increased silt and very fine sand content.
9							
10		1.3	100%	3 3 2		SM/ ML	Grading to silty very fine SAND/very fine sandy SILT, yellow-brown (10YR 5/4), micaceous, slightly moist.
11		1.3	100%	3 4 4			
12							As above w/ trace orange mottling.
13		1.1	100%	2 1 1			Decreased silt content below 13.2' BGS.
14		1.1	90%	2 2 2		SM	Silty very fine to fine SAND, yellow-brown (10YR 5/4), 20-30% silt, trace organics (roots), slightly moist.
15							
16		1.1	85%	2 3 3			Color change to dark yellow-brown (10YR 4/4).
17		1.3	100%	4 4 5			
18						ML	Very fine sandy SILT, brown (10YR 5/3), trace carbonized and non-carbonized organics, abundant orange mottling, slightly moist.
19		1.6	90%	2 3 4		ML/ CL	Clayey SILT/silty CLAY, dark gray-brown (10YR 4/2), abundant orange mottling, 10-15% organics, stiff, slightly moist.
20						ML	As above w/ increased silt content.



Drilled By: Cascade Drilling

Drill Method: Hollow Stem Auger

Drill Date: 22 October 2002

Well Casing Elevation: 37.30'

Ground Surface Elevation: 34.38'

Borehole Diameter: 10-1/4"

Datum: NGVD-29

Sheet: 1 of 2

Project No: 8601526.002.1008

Project: Oregon Steel Mills

Client: Oregon Steel Mills

Location: Portland, OR

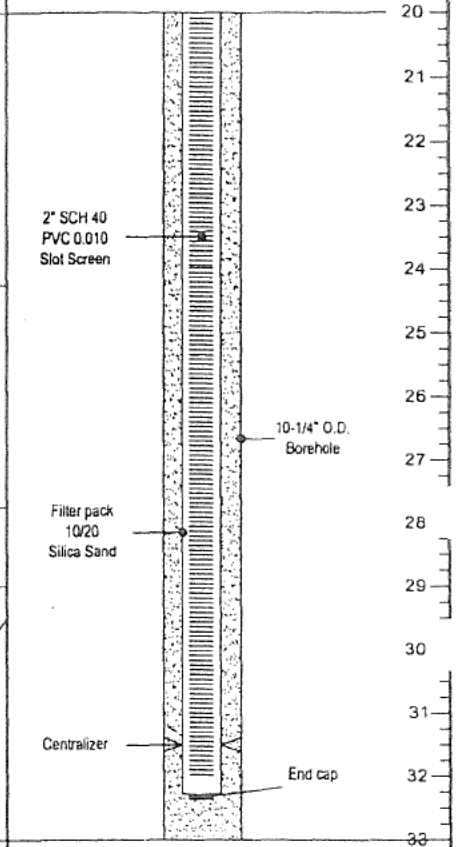
Monitoring Well: MW-11

Ground surface: Gravel

Geologist: E. Dodak, L. McWilliams

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION
20		1.6	70%	2 2 4		ML	Very fine sandy SILT, dark yellow-brown (10YR 4/4), 30-40% sand, some orange mottling, moist.
21							
22		1.6	70%	2 2 3			Color change to brown (10YR 4/3) w/ decreased sand content and some clay (10-20%).
23		1.6	90%	1 2 3			Very fine sandy SILT, dk. yellow-brown (10YR 4/4), some orange mottling and carbonized organics, very moist.
24							
25		1.3	95%	1 1 2		ML/ SM	Silty very fine SAND/ very fine sandy SILT, dark green-gray (5GY 3/1), micaceous, trace orange mottling, wet to very moist.
26		--	--	--			
27						▼	
28		0.2	100%	2 1 2		SM	Silty very fine to fine SAND, greenish black (5GY 2.5/1), 20-30% silt, wet.
29		0.0	100%	1 1 1		ML	Grading to SILT, dark green-gray (5GY 3/1), some orange mottling, moist.
30						SM	Silty very fine to fine SAND, dark yellow-brown (10YR 4/4), 20-30% silt, wet.
31		0.0	100%	0 1 1			Increased silt content (~40%), 30.5-31.0' BGS.
32		0.0	100%	2 1 1			Very fine sandy silt zone 31.6-31.9' BGS.
33							Total depth 33' BGS.
34							
35							
36							
37							
38							
39							
40							

WELL CONSTRUCTION DETAIL



Drilled By: Cascade Drilling

Drill Method: Hollow Stem Auger

Drill Date: 22 October 2002

Well Casing Elevation: 37.30'

Ground Surface Elevation: 34.38'

Borehole Diameter: 10-1/4"

Datum: NGVD-29

EX™

Project No: 8601526.002.1008

Project: Oregon Steel Mills

Client: Oregon Steel Mills

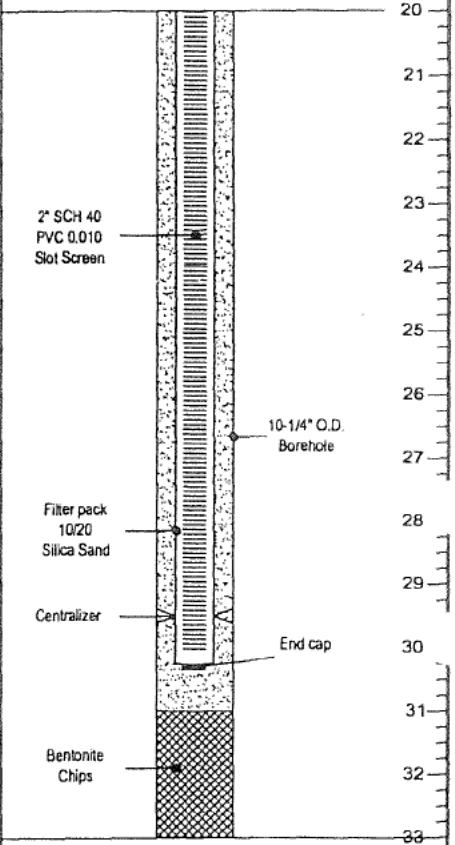
Location: Portland, OR

Monitoring Well: MW-10

Ground surface: Soil

Geologist: E. Dodak, L. McWilliams

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)/ Sudan IV	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION
20		0.0 --	90%	1 1 1		ML	SILT, very dark gray (5Y 3/1), soft, very moist.
							As above w/ trace noncarbonized wood.
21		0.0 --	100%	1 2 1			As above, very moist to wet.
							Moderately stiff from 21.5-22.0' BGS.
22						SM	Silty very fine to fine SAND, very dark gray (5Y 3/1), 30-40% silt, very moist.
23		0.0 --	100%	1 1 1		ML	Slightly sandy SILT, dark gray (5Y 4/1), ~10% very fine sand, soft, very moist to wet.
24		0.0 --	100%	1 1 -12"			Increased sand content (30-40%), 24.2-25.0' BGS.
25							Sand absent below 25.0' BGS, trace organics.
26		0.0 --	100%	1- 12" 1			Color change to brown (10YR 5/3) w/ 20-30% sand, some orange mottling.
							Silty CLAY layer from 26.2-26.4'.
27		0.0 --	100%	1 - 12" 1			As above w/ sand content 15-25%. Clay rich zones 27.5-27.6' and 28-28.1' BGS.
28						CL	Silty CLAY, lt. brown-gray (2.5Y 6/2).
29		0.0 --	100%	1 - 12" 1		SM/ ML	Silty very fine SAND/ very fine sandy SILT, yellow-brown (10YR 5/4), some orange mottling, very moist to wet.
30		0.0 --	100%	1 1 1			
31						SM	Grading to silty very fine SAND, dark yellow-brown (10YR 4/4), 25-35% silt, wet.
32		0.0 --	100%	1 - 18"		ML	Very fine sandy SILT, dark yellow-brown (10YR 4/4) 15-30% sand, some orange mottling, very moist.
33							Total depth 33' BGS.
34							
35							
36							
37							
38							
39							
40							



Drilled By: Cascade Drilling

Drill Method: Hollow Stem Auger

Drill Date: 23 October 2002

Well Casing Elevation: 35.78'

Ground Surface Elevation: 33.21'

Borehole Diameter: 10-1/4"

Datum: NGVD-29

Project No: 8601526.002.1007

Project: Oregon Steel Mills

Client: Oregon Steel Mills

Location: Portland, OR

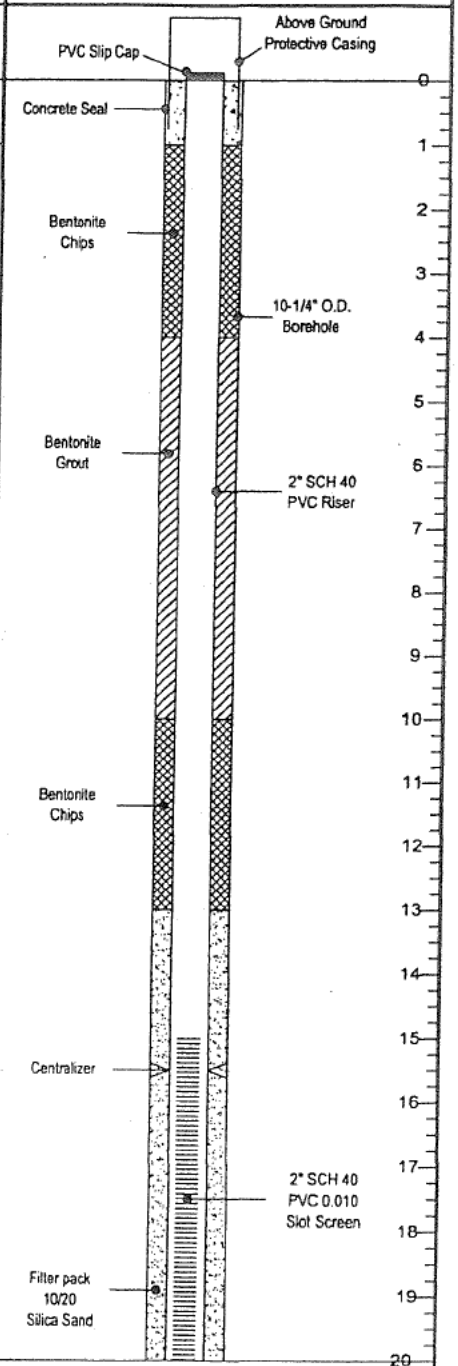
Monitoring Well: MW-10

Ground surface: Soil

Geologist: E. Dodak, L. McWilliams

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)/ Sudan IV	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION
0						SM	Gravelly silty SAND, dark yellow-brown (10YR 4/4), fine to medium sand, gravel up to 1-1/2" dia., moist.
1		2.3 --	65%	8 10 10		GW	Sandy GRAVEL (slag), dark gray (10YR 4/1), fine gravel to 1" dia., fine to coarse sand, slightly moist.
2		2.4 --	70%	6 11 10			Color change to very dark gray (10YR 3/1).
3		3.0 --	40%	6 6 3			As above w/ coarser gravel coated with a white material.
4							
5		2.4 --	30%	9 5 2			
6						ML	SILT, dark gray (10Y 4/1), trace to some micaceous sand, moist.
7		2.6 N	90%	6 5 4			Gravelly sandy SILT, dark gray (2.5Y 4/1), fine to medium sand, gravel up to 1" dia., moist. Color change to olive-gray (5Y 4/2).
8		2.0 N	90%	13 20 10			Color change to dark gray-brown (10YR 4/2).
9							Color change to dark green-gray (10YR 4/1), weak to moderate petroleum-like odor from 8.5-9.0' BGS.
10		2.2 N	75%	10 5 5		SM	Gravelly silty SAND, dark gray (5YR 4/1), fine sand, 30-35% silt, 10-15% gravel, indistinct to weak petroleum-like odor, moist.
11		2.5 N	50%	3 3 3			As above w/ no petroleum-like odor, dark gray (2.5Y 4/1), trace wood.
12							
13		2.2 --	30%	5 4 3			Sample recovery mostly wood.
14		0.0 --	60%	3 1 2			Sample recovery mostly wood. Silty SAND, very dark gray (5Y 3/1), fine sand, 25-35% silt, trace gravel, moist.
15							
16		0.0 --	50%	2 1 1			SILT layer, dark gray (2.5Y 4/1), from 16.1-16.2' BGS.
17		0.0 --	60%	5 3 3		SP	Fine SAND, very dark gray (10YR 3/1), loose moist. As above w/ trace fine rounded gravel.
18							
19		0.0 --	70%	1 1 1			As above, moist to wet.
20						ML	Grading to SILT, very dark gray (5Y 3/1), soft, very moist.

WELL CONSTRUCTION DETAIL



Drilled By: Cascade Drilling

Drill Method: Hollow Stem Auger

Drill Date: 23 October 2002

Well Casing Elevation: 35.78'

Ground Surface Elevation: 33.21'

Borehole Diameter: 10-1/4"

Datum: NGVD-29

Sheet: 1 of 2

EX™

Project No: 8601526.002.1008

Project: Oregon Steel Mills

Client: Oregon Steel Mills

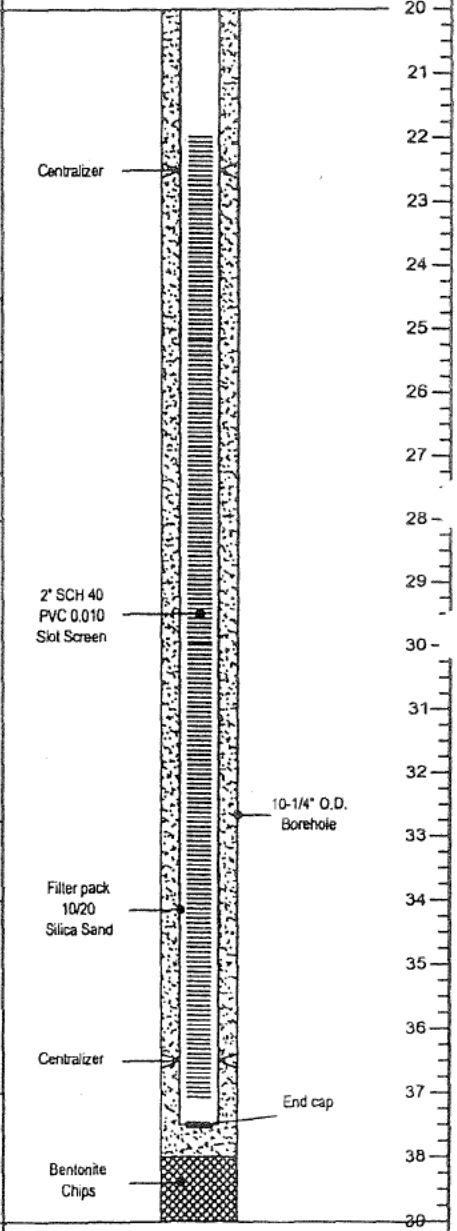
Location: Portland, OR

Monitoring Well: MW-9

Ground surface: Grass (Top of soil berm)

Geologist: E. Dodak, L. McWilliams

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION
20		0.5	15%	17 19 22		GW	GRAVEL (slag), gray (N 5/), up to 1" dia., moist.
21		0.5	75%	37 34 30			Sandy GRAVEL (slag), dark gray (N 4/), gravel up to 1" dia., trace metal fragments.
22							
23		0.5	50%	18 29 11			Color change to dark gray (N 3/).
24		0.5	90%	2 1 2		SM	Silty fine SAND, brown (10YR 4/3), 10-20% silt, moist, no petroleum-like odor.
25						SP	Fine SAND, brown (10YR 4/3), trace silt and fine gravel, moist.
26		0.5	75%	2 2 1			
27						SM	Silty fine SAND, brown (10YR 4/3), 25-35% silt, moist.
28		0.8	100%	1 2 1		SP	Fine SAND, dk. gray-brown (10YR 4/2), moist. Silt content 25-30% from 28.5-29.0' BGS.
29		0.1	80%	2 2 2			
30							Color change to dark brown (10YR 3/3).
31		0.5	100%	1 2 1			Wet @ 31' BGS, no petroleum-like odor. Color change to very dark gray (2.5Y 3/1) below 31.2' BGS, fine to medium sand, trace silt.
32		0.5	100%	1 1 1			As above w/ 3/4" thick wood layers @ 31.5 and 32.5' BGS.
33						ML	SILT, dark gray (5Y 4/1), slightly stiff, trace very fine sand, no petroleum-like odor or sheen.
34		0.5	100%	1 2 1			As above w/ 10-25% fine sand.
35		0.5	100%	2 2 3		SP	Fine SAND, very dark gray (N3 /), trace silt, wet, no petroleum-like odor. As above.
36		0.5	100%	1 1 1			As above w/ 0.1' wood @ 37.1' BGS.
37						ML	Very fine sandy SILT, dark gray (5Y 4/1), 20-30% sand, trace wood.
38		0.5	100%	1 1 1			
39							Total depth 39' BGS.
40							



Drilled By: Cascade Drilling

Drill Method: Hollow Stem Auger

Drill Date: 29 and 30 October 2002

Well Casing Elevation: 40.95'

Ground Surface Elevation: 38.42'

Borehole Diameter: 10-1/4"

Datum: NGVD-29

Sheet: 2 of 2

Sta 14+50

berm just N of dock

EX™

Project No: 8601526.002.1007

Project: Oregon Steel Mills

Client: Oregon Steel Mills

Location: Portland, OR

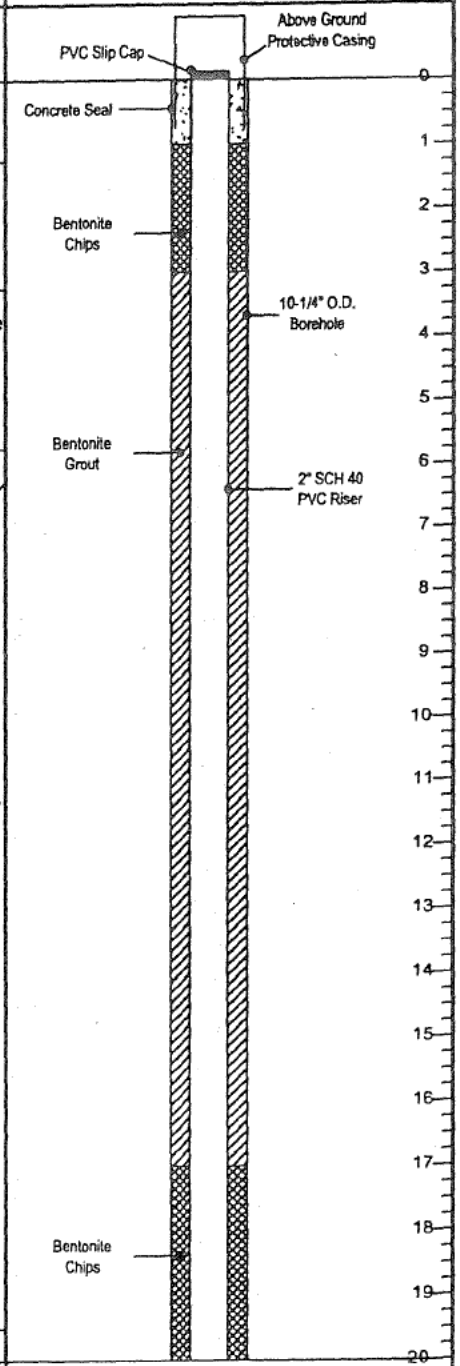
Monitoring Well: MW-9

Ground surface: Grass (Top of soil berm)

Geologist: E. Dodak, L. McWilliams

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION
0						SM	Silty fine SAND, brown (10YR 5/3), 20-30% silt, 5-10% gravel up to 1/2" dia., dry.
1		1.0	80%	3 5 7			
						ML	SILT, brown (10YR 4/3), trace roots and gravel, stiff, trace orange mottling, moist.
2		1.4	50%	3 2 3			As above w/ trace coarse sand.
3						SM	Silty fine SAND, brown (10YR 5/3), 30-40% silt, trace fine gravel, moist, no petroleum-like odor.
4		1.4	65%	2 2 2			
5		0.7	65%	1 2 2			
6						ML	Very fine sandy SILT, dark gray (5Y 4/1), trace roots, moist.
						SM	Silty fine SAND, dark yellow-brown (10YR 4/4), 20-30% silt, trace gravel, moist.
7		0.7	70%	1 5 8			
8		1.0	70%	6 8 10			Sandy GRAVEL (slag) layer from 8.2-8.5' BGS, gray (N 5/).
9							
10		1.0	65%	10 13 13			As above, color change to grayish brown (10YR 5/2), ~10% gravel (up to 1" dia.).
11		0.5	50%	18 20 23			As above, color change to brown (10YR 4/3), ~1-1/2" dia. piece of broken gravel (slag) @ 11.5' BGS.
12							
13		0.1	100%	5 5 7			
14		0.5	90%	4 2 2			Color change to dark yellow-brown (10YR 4/4), 30-40% silt.
15							
16		0.5	70%	1 0 1			As above, decreased gravel content. White chalky material (1" thick) at 16.5' BGS.
17		0.5	50%	1 3 5			Gravel (slag) content 30-40% below 17.5'.
18							
19		0.1	20%	27 3 1			As above, color change to grayish brown (10YR 5/2), some white chalky material.
						GW	GRAVEL (slag), gray (N 5/) to 1" dia., moist.
20							

WELL CONSTRUCTION DETAIL



Drilled By: Cascade Drilling

Drill Method: Hollow Stem Auger

Drill Date: 29 and 30 October 2002

Well Casing Elevation: 40.95'

Ground Surface Elevation: 38.42'

Borehole Diameter: 10-1/4"

Datum: NGVD-29

EX™

Project No: 8601526.002.1007

Project: Oregon Steel Mills

Client: Oregon Steel Mills

Location: Portland, OR

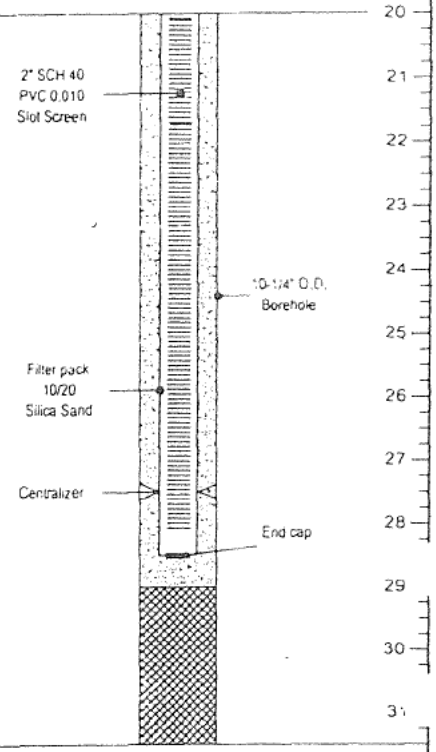
Monitoring Well: MW-8

Ground surface: Gravel

Geologist: E. Dodak, L. McWilliams

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION
20						SP	Fine SAND, brown (10YR 4/3) w/ trace silt, moist.
21		0.0	90%	2 2 2			
22		0.7	90%	2 3 2			Color change to dark gray (10YR 4/1), mostly fine sand.
23		0.9	100%	1 1 2			▼ Wet @ 22.8' BGS. Color change to v. dark gray (10YR 3/1). As above w/ wood layer at 23.5' BGS.
24		0.5	100%	1 1 1			As above, wood layer (0.2' thick) @ 24.5' BGS
25						SM/ML	Interlayered silty fine SAND / fine sandy SILT v. dk. gray (10YR 3/1), v. moist.
26		0.5	100%	1 1 1		ML	Very fine sandy SILT, dark gray (10YR 4/1), 10-20% v. fine sand, moist.
27						SP	Fine SAND, very dark gray (N 3/), 5-10% silt, wet.
28		1.4	70%	1 1 1		SM	Silty very fine SAND, very dark gray (7.5YR 3/1), 30-40% silt.
29		1.4	100%	1 0 1		ML	SILT, v. dark gray (5Y 3/1), moderately stiff, moist, no petroleum-like odor. V. fine sandy SILT, v. dark gray (5Y 3/1), 30-40% sand. SILT layer 29-29.5' BGS, dark gray (5Y 4/1) w/ trace wood, moderately stiff, moist, no petroleum-like odor.
30		1.0	100%	2 2 3			
31							Total depth 31.5' BGS.
32							
33							
34							
35							
36							
37							
38							
39							
40							

WELL CONSTRUCTION DETAIL



Drilled By: Cascade Drilling

Drill Method: Hollow Stem Auger

Drill Date: 28 and 29 October 2002

Well Casing Elevation: 33.97'

Ground Surface Elevation: 31.78'

Borehole Diameter: 10-1/4"

Datum: NGVD-29

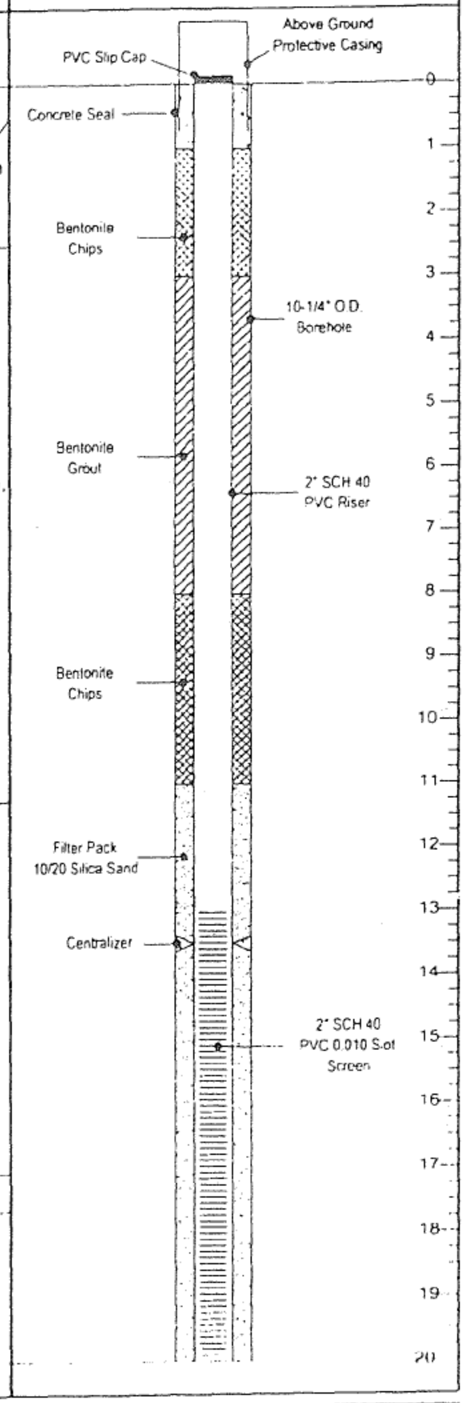
Sheet: 2 of 2

Station 16+50

Project No: 8601526.002.1007	Monitoring Well: MW-8
Project: Oregon Steel Mills	
Client: Oregon Steel Mills	Ground surface: Gravel
Location: Portland, OR	Geologist: E. Dodak, L. McWilliams

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	GROUP SYMBOL	LITHOLOGIC DESCRIPTION
0–1.5		0.1	90%	9 6 6	GP	Fine GRAVEL, dark gray (10YR 4/1), moist.
					GW	Sandy fine GRAVEL (slag), v. dark gray (N 3/), trace white powdery material, medium to coarse sand, moist.
1.5–3		0.0	80%	7 6 7	SM	Silty fine SAND, brown (10YR 4/3), 30-40% silt, trace fine gravel, moist.
3–4.5		0.0	75%	3 4 7		Color change to dark brown (10YR 3/3), 15-20% gravel (some slag).
4.5–6		0.3	30%	3 3 4		
6–7.5		0.3	70%	4 4 7		As above, color change to brown (10YR 4/3), gravel up to 1.5" dia. (slag).
7.5–9		0.7	50%	2 2 2		As above w/ gravel up to .75" dia. (slag).
9–10.5		0.9	75%	2 2 3		As above, decreased silt (10-20%) and gravel (5%) content below 10' BGS.
10.5–12		1.1	75%	2 2 2	SP	Slightly silty, fine SAND, brown (10YR 4/3), 10-15% silt, moist.
12–13.5		0.7	35%	3 7 5		
13.5–15		0.5	90%	5 3 4		
15–16.5		0.5	90%	2 2 4		As above, trace silt below 15.8' BGS.
16.5–18		0.7	100%	2 2 3	SM	Silty SAND, 20-30% silt 17.0-17.5' BGS
					SP	
18–19.5		1.3	100%	1 1 2		

WELL CONSTRUCTION DETAIL



Drilled By: Cascade Drilling	Well Casing Elevation: 33.97'	Datum: NGVD-29
Drill Method: Hollow Stem Auger	Ground Surface Elevation: 31.78'	
Drill Date: 28 and 29 October 2002	Borehole Diameter: 10-1/4"	Sheet: 1 of 2

EX™

Project No: 8601526.002.1008

Project: Oregon Steel Mills

Client: Oregon Steel Mills

Location: Portland, OR

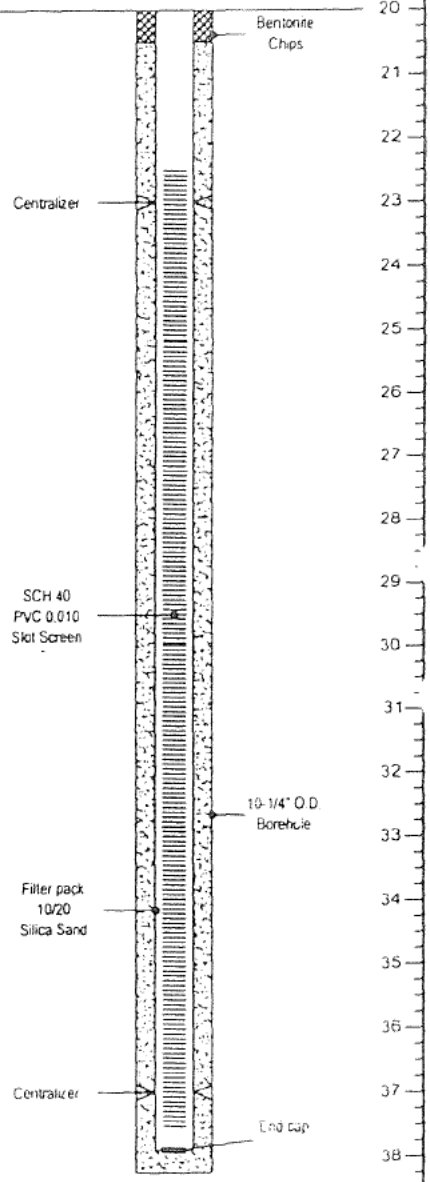
Monitoring Well: MW-7

Ground surface: Grass / soil (Top of soil berm)

Geologist: E. Dodak, L. McWilliams

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)/ Sudan IV	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION
20		3.2	100%	2 3 3		SP	Fine SAND, dark gray-brown (10YR 4/2), trace rounded gravel, loose, moist.
21		3.7	85%	3 3 4			
22		2.0	90%	2 2 5			
23		1.8	100%	2 6 7			As above w/ fine to medium sand.
24		2.4	100%	3 2 5			As above w/ piece of wood @ 26.5' BGS.
25		2.2	90%	3 4 4			
26		2.4	85%	3 3 3			As above w/ 10-15% at 28.5 and 29.8' BGS.
27		2.7 N	80%	3 3 4		▼	Wet @ 30.8' BGS, some orange banding. Mostly fine sand no gravel, color change to very dark gray (N 3/).
28		4.6 N	100%	2 2 3			As above, weak petroleum-like odor, no sheen.
29		4.0 N	75%	3 3 3			
30		2.4 N	100%	2 2 4			
31		2.6 N	100%	1 3 3			No evidence of petroleum on top of silt.
32		1.6 N	100%	2 2 1		ML	SILT, dark gray (2.5Y 4/1), moderately stiff, trace organics, moist. As above w/ 10-15% very fine sand from 38-38.3' BGS
33							Total depth 38.4' BGS. Sampled to 39' BGS.
34							
35							
36							
37							
38							
39							
40							

WELL CONSTRUCTION DETAIL



Drilled By: Cascade Drilling

Drill Method: Hollow Stem Auger

Drill Date: 24/25 October 2002

Well Casing Elevation: 41.73'

Ground Surface Elevation: 38.24'

Borehole Diameter: 10-1/4"

Datum: NGVD-29

Sheet: 2 of 2

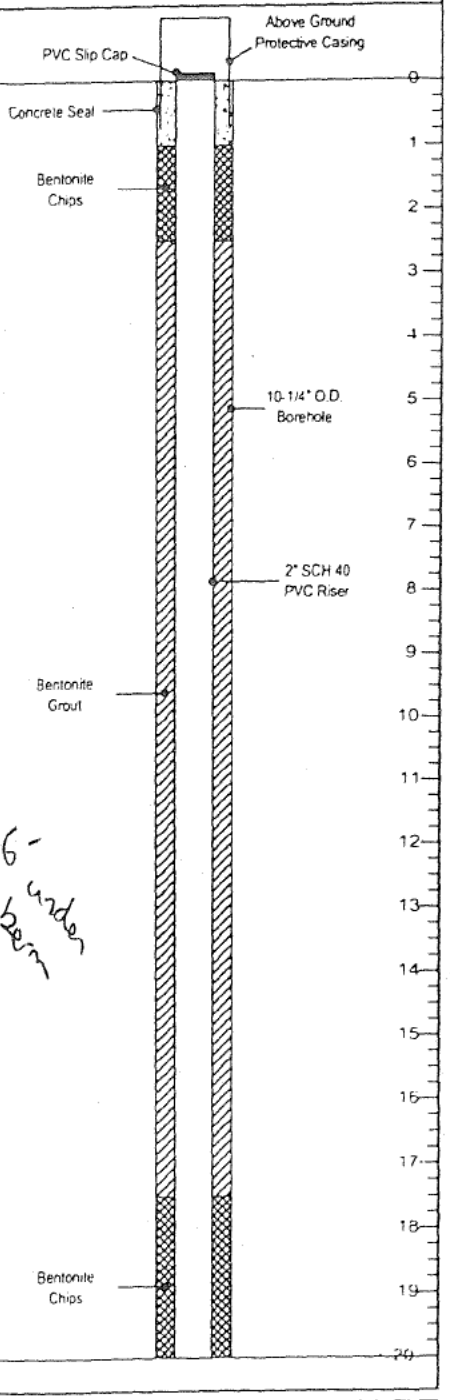
Sta 19+10

Berm - South end bank

EX™

Project No: 8601526.002.1008	**Monitoring Well:** MW-7
Project: Oregon Steel Mills	
Client: Oregon Steel Mills	**Ground surface:** Grass / soil (Top of soil berm)
Location: Portland, OR	**Geologist:** E. Dodak, L. McWilliams

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)/ Sudan IV	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION
0							
1		2.8 --	90%	3 2 3		SP	Fine SAND, dark yellow-brown (10YR 4/4), trace fine gravel and silt, moist.
2		3.4 --	60%	2 3 5			As above w/ decreased silt content.
3		3.4 --	70%	2 2 4			As above w/ trace gravel up to 1" dia.
4		--	--	--			As above w/ 10-15% silt, trace organics.
5		3.4 --	80%	3 1 2			As above w/ decreased gravel and silt content. Increased silt content @ ~7.4' BGS.
6		3.4 --	90%	8 8 9		ML	Sandy gravelly SILT, v. dark gray-brown (10YR 3/2), fine gravel to 1" dia. (mostly slag) 20-30%, fine to coarse sand 15-20%, moist.
7		3.2 --	70%	10 11 36			Color change to very dark gray (10YR 4/1). Large rock (slag) ~1-1/2" dia. @ 10.3' BGS.
8		3.2 --	70%	5 6 8		SM	Gravelly silty fine SAND, yellow-brown (10YR 5/4), 25-35% silt, 5-10% gravel (mostly slag) up to 1" dia., moist.
9		2.8 --	70%	6 7 7			Decreased gravel content.
10		3.0 --	65%	2 3 2		SP	Fine SAND, brown (10YR 4/3) to dark gray brown (10YR 4/2), trace fine gravel (no slag), loose, moist.
11		3.9 --	70%	2 1 1			
12		2.6 --	75%	1 0 1			Very fine sandy SILT lamination (0.03' thick) @ 17.8' BGS.
13		3.7 --	80%	1 2 2			As above w/ decreased gravel content.
14							As above w/ 5-10% silt from 19.5-20' BGS.
15							
16							
17							
18							
19							
20							



Drilled By: Cascade Drilling	**Well Casing Elevation:** 41.73'	**Datum:** NGVD-29
Drill Method: Hollow Stem Auger	**Ground Surface Elevation:** 38.24'	
Drill Date: 24/25 October 2002	**Borehole Diameter:** 10-1/4"	**Sheet:** 1 of 2

EX™

Project No: 8601526.002.1007

Project: Oregon Steel Mills

Client: Oregon Steel Mills

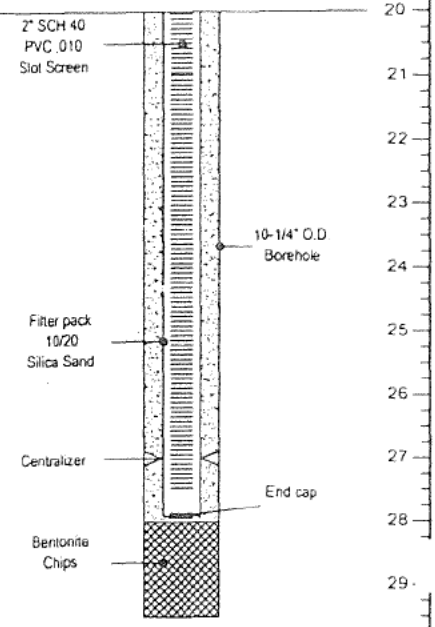
Location: Portland, OR

Monitoring Well: MW-5

Ground surface: Gravel

Geologist: E. Dodak, L. McWilliams

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)/ Sudan IV	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION
20		2.4 --	65%	3 3 2		SP	Fine SAND, brown (10YR 4/3), trace silt, moist.
21		3.1 --	90%	4 4 .5			As above, mostly fine sand, very moist. Color change to dark gray-brown (10YR 4/2).
22		3.1 --	85%	3 4 4			Color change to dk. yellow-brown (10YR 3/4).
23		2.7 --	90%	4 3 4			Wet at 24.8' BGS.
24		2.4 N	100%	3 2 2			As above, 5-10% silt below 25' BGS.
25		2.7 N	100%	2 1 1			Color change to v. dk. gray-brown (2.5Y 3/2).
26		2.7 N	75%	1 1 1		ML	Color change to black (N 2.5/) below 27' BGS, no silt, weak petroleum-like odor.
27							SILT, dark gray (5Y 4/1), very stiff, no petroleum-like odor. No evidence of petroleum at SP/ML contact.
28							
29							
30							Total depth 29.5' BGS, sampled to 30' BGS.
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							



Drilled By: Cascade Drilling

Drill Method: Hollow Stem Auger

Drill Date: 25 and 28 October 2002

Well Casing Elevation: 34.68'

Ground Surface Elevation: 32.37'

Borehole Diameter: 10-1/4"

Datum: NGVD-29

Sheet: 2 of 2

STA 22+30

property boundary

EX™

Project No: 8601526.002.1007

Project: Oregon Steel Mills

Client: Oregon Steel Mills

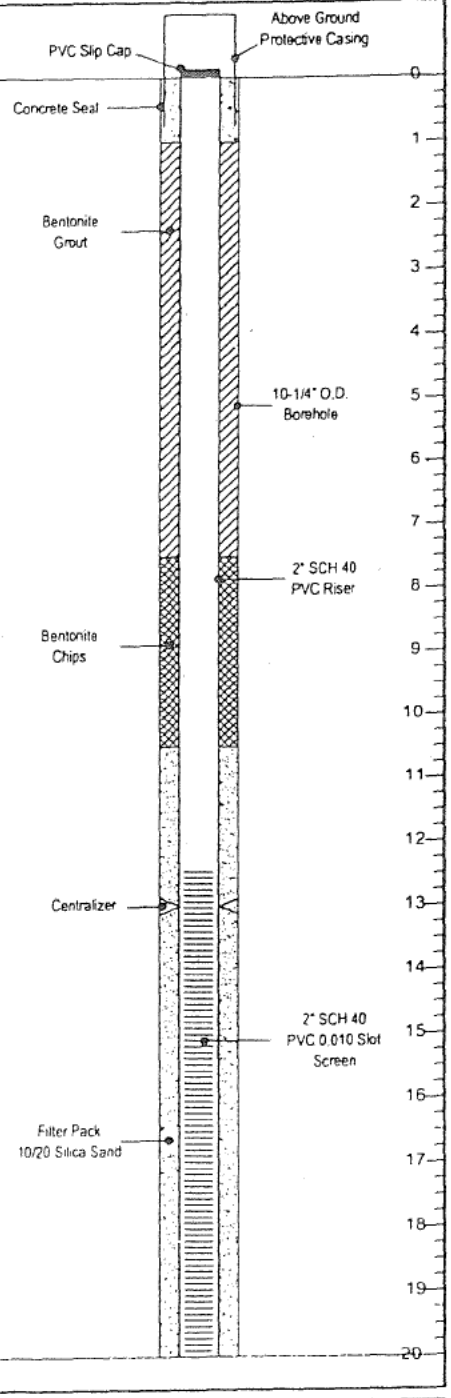
Location: Portland, OR

Monitoring Well: MW-5

Ground surface: Gravel

Geologist: E. Dodak, L. McWilliams

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)/ Sudan IV	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION
0						GW	Sandy silty GRAVEL, brown (10YR 4/3), rounded gravel up to 1-1/2" dia., moist.
1		3.7 N	25%	3 2 3			
2		13.3 N	20%	4 4 2		SM	Gravelly silty fine SAND, dark gray-brown (10YR 4/2), 25-35% silt, fine gravel (slag), moist.
3		3.5 N	<5%	3 2 2			Mostly gravel.
4						SP	Fine SAND, brown (10YR 4/3), loose, moist.
5		3.3 --	70%	2 2 3			
6		3.1 --	100%	4 4 4			
7		3.3 --	90%	1 2 1			
8		3.7 --	90%	3 2 2			
9		2.5 --	100%	2 1 2		ML	Very fine sandy SILT, dark gray-brown (10YR 4/2), 25-35% v. fine sand, moist.
10		2.7 --	90%	1 2 3		ML/ SM	Interlayered fine sandy SILT, dark gray-brown (10YR 4/2), and silty fine sand, brown (10YR 4/3). As above w/ trace organics in silts.
11		2.9 --	90%	2 3 4		SP	Fine SAND, brown (10YR 4/3), trace silt, loose, moist. V. fine sandy SILT layer from 13.2-13.4' BGS, dark gray-brown (10YR 4/2). As above, fine to medium sand.
12		3.1 --	80%	2 3 5			As above w/ trace rounded gravel.
13		3.3 --	90%	3 3 4			
14		3.1 --	90%	2 2 4			
15							
16							
17							
18							
19							
20							



Drilled By: Cascade Drilling

Drill Method: Hollow Stem Auger

Drill Date: 25 and 28 October 2002

Well Casing Elevation: 34.68'

Ground Surface Elevation: 32.37'

Borehole Diameter: 10-1/4"

Datum: NGVD-29

Sheet: 1 of 2

Sh 10 of 75

berm by central outfall

Boring/Well Log

RETEC

Well #: MW-13
Sheet 1 of 3

Project: SCE-TPH GW	Monument: Stick up	Stick Up: 6" steel protective casing
Project #: STRE1-18713-432	Northing: 724013.8 Easting: 1415718.6	Ground Elevation: 32.98
Location: OSM	Drill Rig Type: CME 75 rubber track rig	MP Elevation: 35.17
Client: Stoel Rives	Method: Hollow Stem Auger	Total Depth: 31.5'
Start Date & Time: 09/07/2005 0800	Casing ID: 2"	Filter Pack: 13-30' #10/20
Finish Date & Time: 09/07/2005 1000	Boring ID: 6.25"	Seal: 2-13' Bentonite chips
Contractor: Cascade	Bit Type: 6.25" HSA	Grout: -
Operator: Scott	Logged By: R. Knecht	Screen: 0.010-inch Slot Sch. 40 PVC 15-30'

Sample Type & #	Depth Range	% Rec	Blows per 6"	PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS)	Elevation (ft.)	Comments
							0		0	
SS		100	50/6"	0.6				0-0.5' SM: Brown fine-grained SAND and SILT, 30% fine-grained subangular gravel, 0-0.2' many rootlets and organics, 0.2-0.4' few rootlets and organics, 0.4-0.5' trace wood fragments, damp.		
								0.5-1.5' No recovery.		
SS		100	50/6"	5.4				1.5-2.0' SM: Brown fine-grained SAND and SILT, 30% fine-grained subangular to subrounded gravel, 1.5-1.7' little organics and roots, few wood fragments, damp, organic grassy odor.		
								2.0-3.0' No recovery.		
SS		63.8	20/24 /26	26.7				3.0-4.5' Very dark gray to black course-grained SAND to fine-grained GRAVEL subangular to subrounded, 15% medium-grained sand, 10% large-grained subangular to angular gravel, damp, no odor, no visual product.		
SS		55.5	18/21 /24	17.6			5	4.5-7.0' Dark gray to black coarse-grained SAND to fine-grained GRAVEL subangular to angular, 10% medium-grained sand, damp, no odor, no visual product.	-5	
SS		44.4	11/7/7	1.6						
SS		61	6/4/4	1.9				7.0-9.75' GP: Brown to light brown rounded to subrounded fine-grained GRAVEL, 20-30% fine to medium-grained sand, damp to wet, no odor, from 9-9.75 slightly salty odor, no visual product, looks like pea gravel.		

MW-13
2 of 3

ss		55.5	18/20 /23	4.1		9.75-10.5' SW: Brown with white flecks of ash-like material fine to medium-grained SAND, 20% coarse-grained sand to fine-grained subangular gravel, one subangular cobble at 9.75', wet, no odor.
ss		44.4	14/8/6	1.1	10	10.5-11.5' GP: Black to brown fine-grained GRAVEL, 20% coarse-grained sand, 20% medium-grained sand, wet to damp, no odor, no visual product.
						11.5-12.0' SP: Brown to yellowish brown fine-grained SAND, 30% medium-grained sand, sand in consolidated pieces feels like gravel, < 5% silt, damp, no odor.
ss		42	8/10/10	55.0		12.0-13.5' SW: Brown to yellowish brown fine to medium-grained SAND, 20% fine-grained subangular gravel, damp to wet, no odor, no visual product.
ss		51	7/7/8	4.8		13.5-15.0' SW: Brown fine to medium-grained SAND, <5% fine-grained subrounded gravel, vertical lense of black gravelly shiny layer, damp, no odor, no visual product.
ss		78	5/6/6	11.7	15	15.0-16.5' SW: Brown to yellowish brown fine to medium-grained SAND, <5% fine-grained subangular to subrounded gravel, layer of fine-grained subangular gravel at 15.0-15.2', damp to wet, no odor, no visual product.
ss		78	5/6/7	24.5		16.5-18.0' SW: Brown to yellowish brown fine to medium-grained SAND, <5% fine-grained subangular to subrounded gravel, one large subangular to angular gravel at 17.2', damp to wet, no odor, no visual product.
ss	18-19.5	72	10/10 /12	226		18.0-19.5' SP: Brown to slightly yellowish brown fine-grained SAND, 20% medium-grained sand after black organic/woody layer at 18.7', one large-grained rounded gravel at 18.7' just above black organic/woody layer, wet to damp, no odor, no visual product.
ss		55.5	18/20 /23	238	20	19.5-21.0' SW: Brown with trace white flecks, fine to medium-grained SAND, loose, damp to wet, no odor, no visual product.
ss		32	32/ 50/5"	4.8		21.0-22.0' SW: Brown fine to medium-grained SAND, 10% silt, <5% rounded gravel, black layer of sand and silt at 21.2', loose, wet.
						22.0-22.5' No recovery.
ss		28	18/20 /23	870		22.5-24.0' SW: Brown grading to gray fine to medium-grained SAND, silt content increases going down section, wet, loose, slight salty odor.

MW-13
3 of 3

ss		75	8/9/10	78.1		24.0-25.0' SP: Brown with pockets of gray fine-grained SAND, 20% medium-grained sand, 10% silt, <5% coarse-grained sand, wet, no odor, no visual product.	
					25	25.0-25.2' Large-grained subangular COBBLE.	-25
						25.2-25.5' SP: Brown with pockets of gray fine-grained SAND, 20% silt, silt coating outside of split spoon soil, wet, no odor, no visual product.	
ss		67	6/7/7	10.9		25.5-27.0' ML: Brown to light yellowish brown SILT, 5-10% fine-grained sand, light gray and reddish brown layering of silt at 26.5' and 27.0' approximately 1 to 2 mm thick, wet, no odor, no visual product.	
ss		83	5/6/6	603		27.0-28.5' ML: Brown and gray with red mottling SILT and gray fine-grained SAND, <5% fine-grained rounded gravel, wet, very soft, silt in gray layers with red mottles at 28.2-28.5', no odor, no visual product.	
ss	28.5-30	72	3/4/5	39.0		28.5-30.0' ML: Gray to light gray with brown red mottles throughout section SILT, wet, no odor, no visual product.	
					30		-30
ss		89	3/4/4	12.4		30.0-30.75' SP: Gray with red brown mottles very fine-grained SAND, 20% silt, wet, no odor, no visual product.	
						30.75-31.5' ML: Gray with red brown mottles SILT, wet, high plasticity, no odor, no visual product.	

Boring drilled only to 30 feet bgs split spoon taken from 30 to 31.5 feet bgs.

Remarks and Datum Used:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)

Sta 19+25

Beach - just south of southern remedy

Boring/Well Log

RETEC

Well #: MW-14
Sheet 1 of 2

Project: SCE-TPH GW	Monument: Stick up	Stick Up: 6" steel protective casing
Project #: STRE1-18713-432	Northing: 723225.9 Easting: 1415377.0	Ground Elevation: 12.41
Location: OSM	Drill Rig Type: CME 75 rubber track rig	MP Elevation: 14.34
Client: Stoel Rives	Method: Hollow Stem Auger	Total Depth: 15'
Start Date & Time: 09/01/2005 1100	Casing ID: 2"	Filter Pack: 8-15' #10/20
Finish Date & Time: 09/01/2005 1300	Boring ID: 6.25"	Seal: 1-8' Bentonite chips
Contractor: Cascade	Bit Type: 6.25" HSA	Grout: -
Operator: Scott	Logged By: R. Knecht	Screen: 0.010-inch Slot Sch. 40 PVC 8.5-15'

Sample Type & #	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS)	Elevation (ft.)	Comments
							0		0	
ss		94	3/3/4	1.0				0.0-1.5' SW: Brown fine to medium-grained SAND, 0.0-0.5' trace <5% fine-grained subangular to rounded gravel, 1.0-1.25' roots and a piece of wood, damp from 1.1-1.5, dry.		PID background 0.2-1.0 ppm
ss		100	3/4/4	4.1				1.5-2.25' SW: Light brown fine to medium-grained SAND, <1% fine-grained subangular gravel, trace wood fragments.		
								2.25-2.5' SP: Brown to reddish brown fine-grained SAND, 15% medium-grained sand, 5% silt, damp to wet, no odor.		
ss	3-3.75	72	3/3/3	2.3				2.5-3.0' SW: Dark gray fine to medium-grained SAND, <%5 coarse-grained sand, few wood pieces, wet.		
								3.0-3.75' SW: Dark gray fine to medium-grained SAND, <5% coarse-grained sand, few white rootlets, slight sweet odor.		
								3.75-4.7' SP: Gray to dark gray fine-grained SAND, 30% silt, wet, few pieces of wood and roots, slight sweet odor.		
ss		67	1/1/1	5.3			5	4.7-6.0' ML: Gray to dark gray SILT, 35% clay, black mottles, soft, wet, slight sweet odor.	-5	
								6.0-8.25' ML: Gray to dark gray SILT, 30% clay, trace black root at 7.5', soft, wet.		
ss		83	1/1/2	1.6						
ss		50	2/3/3	0.0				8.25-9.0' SP: Gray to dark gray fine-grained SAND, wet, soft, slight sweet odor.		
								9.0-10.5' SP: Gray to dark gray fine-grained SAND, 5-10% silt, wet, trace light brownish gray bands (layering), few wood fragments at 9.0-9.5, very slight sweet odor.		
ss		72	2/3/3	0.0						

MW-14
2 of 2

ss		75	8/9/10	78.1		24.0-25.0' SP: Brown with pockets of gray fine-grained SAND, 20% medium-grained sand, 10% silt, <5% coarse-grained sand, wet, no odor, no visual product.	
					25	25.0-25.2' Large-grained subangular COBBLE.	-25
						25.2-25.5' SP: Brown with pockets of gray fine-grained SAND, 20% silt, silt coating outside of split spoon soil, wet, no odor, no visual product.	
ss		67	6/7/7	10.9		25.5-27.0' ML: Brown to light yellowish brown SILT, 5-10% fine-grained sand, light gray and reddish brown layering of silt at 26.5' and 27.0' approximately 1 to 2 mm thick, wet, no odor, no visual product.	
ss		83	5/6/6	603		27.0-28.5' ML: Brown and gray with red mottling SILT and gray fine-grained SAND, <5% fine-grained rounded gravel, wet, very soft, silt in gray layers with red mottles at 28.2-28.5', no odor, no visual product.	
ss	28.5-30	72	3/4/5	39.0		28.5-30.0' ML: Gray to light gray with brown red mottles throughout section SILT, wet, no odor, no visual product.	
					30		-30
ss		89	3/4/4	12.4		30.0-30.75' SP: Gray with red brown mottles very fine-grained SAND, 20% silt, wet, no odor, no visual product.	
						30.75-31.5' ML: Gray with red brown mottles SILT, wet, high plasticity, no odor, no visual product.	

Boring drilled only to 30 feet bgs split spoon taken from 30 to 31.5 feet bgs.

Remarks and Datum Used:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)

Sta 18+75

Reach - Downstream Main Remedy Area

Boring/Well Log

RETEC

Well #: MW-15
Sheet 1 of 2

Project: SCE-TPH GW	Monument: Stick up	Stick Up: 6" steel protective casing
Project #: STRE1-18713-432	Northing: 723307.0 Easting: 1415388.6	Ground Elevation: 8.43
Location: OSM	Drill Rig Type: CME 75 rubber track rig	MP Elevation: 12.02
Client: Stoel Rives	Method: Hollow Stem Auger	Total Depth: 19.5'
Start Date & Time: 09/01/2005 1435	Casing ID: 2"	Filter Pack: 3.8-17' #10/20
Finish Date & Time: 09/01/2005 1645	Boring ID: 6.25"	Seal: 0.8-3.8' Bentonite chips
Contractor: Cascade	Bit Type: 6.25" HSA	Grout: -
Operator: Scott	Logged By: R. Knecht	Screen: 0.010-inch Slot Sch. 40 PVC 4-14'

Sample Type & #	Depth Range	% Rec	Blows per 6"	PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS)	Elevation (ft.)	Comments
							0		0	
ss		22	3/2/1	0.0				0.0-1.8' SP: Brown to reddish brown coarse-grained SAND, 30% fine-grained subangular to subrounded gravel, moist, no odor.		
ss		100	1/2/1	0.0				1.8-4.0' ML: Gray to dark gray SILT, 20% clay, <5% fine-grained sand at 2.75-3.0', wet, soft, no odor.		
ss		78	2/3/3	0.6				4.0-4.5' SP: Gray to dark gray fine-grained SAND, 10% silt, trace mica flakes, at 4.3' 1/2" silt lense, wet, no odor.		
ss	4.5-6	67	1/2/2	0.1			5	4.5-6.0' SP: Gray to dark gray fine-grained SAND, 15% silt, trace mica flakes, wet, slight sweet odor.	-5	
ss		61	3/4/4	0.0				6.0-7.5' SP: Gray to dark gray fine-grianed SAND, silt lenses 1/4 to 1/2" thick at 6.25, 6.6 and 7.25', wet, slight sweet odor.		
ss		78	2/2/2	0.0				7.5-9.0' SP: Gray to dark gray fine-grained SAND, 15% silt, trace mica flakes, wet, slight sweet odor.		
ss		67	2/3/3	0.0				9.0-10.5' SP: Gray to dark gray fine-grained SAND, 15% silt, light gray silt lense at 9.25', wet, slight sweet odor.		

MW-15
2 of 2

ss		89	2/3/3	0.0		10	10.5-12.0' SP: Gray to dark gray fine-grained SAND, 10% silt, trace mica flakes, few wood pieces at 10.75', few light brownish gray bands of fine-grained sand at 10.7', wet.	-10
ss	12-13.5	67	2/3/3	0.0			12.0-15.0' SP: Gray to dark gray fine-grained SAND, <5% silt, wet, trace mica flakes, no odor.	
ss		61	2/2/2	0.0		15		-15

Remarks and Datum Used:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sample Type	Groundwater		
N = SPT	Date	Time	Depth (ft.)
DP = Direct Push			
SS = Split Spoon			
C = Core			

MW-14

Sta 16+50

Beach - South of dock

Boring/Well Log

RETEC

Well #: MW-16
Sheet 1 of 2

Project: SCE-TPH GW	Monument: Stick up	Stick Up: 6" steel protective casing
Project #: STRE1-18713-432	Northing: 725482.8 Easting: 1415445.2	Ground Elevation: 11.99
Location: OSM	Drill Rig Type: CME 75 rubber track rig	MP Elevation: 14.72
Client: Stoel Rives	Method: Hollow Stem Auger	Total Depth: 15'
Start Date & Time: 09/02/2005 0745	Casing ID: 2"	Filter Pack: 7.5-15' #10/20
Finish Date & Time: 09/02/2005 0850	Boring ID: 6.25"	Seal: 1-7.5' Bentonite chips
Contractor: Cascade	Bit Type: 6.25" HSA	Grout: -
Operator: Scott	Logged By: R. Knecht	Screen: 0.010-inch Slot Sch. 40 PVC 8-15'

Sample Type & #	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft)	Soil and Rock Description (Classification Scheme: USCS)	Elevation (ft.)	Comments
							0		0	
ss		39	20/25 /35	0.0				0.0-1.5' SP: Brown medium-grained SAND, 10% fine-grained sand, 20% large-grained subrounded to angular, black, crystalline gravel, <5% cobbles subrounded to angular, dry, trace rootlets, no odor.		
ss		44	18/20 /25	0.0				1.5-3.0' SW: Brown fine to medium-grained SAND, 15-20% fine-grained angular to rounded gravel, <5% subrounded cobbles to coarse-grained gravel, damp, no odor.		
ss		53	14/18 /24	0.0				3.0-4.5' SW: Brown fine to medium-grained SAND, 15% fine-grained subangular to rounded gravel, <5% coarse-grained rounded gravel, less gravel from 4.0-4.5', damp to slightly wet, no odor.		
ss	5.25-6	64	13/8/7	0.0			5	4.5-5.25' SW: Brown fine to medium-grained SAND, <5% fine-grained subrounded gravel, damp to slightly wet, moderate sweet odor.	-5	
								5.25-5.8' SW: Black to dark gray fine to medium-grained SAND, <5% coarse-grained sand, damp to wet, moderate sweet odor.		
								5.8-6.0' ML: Gray to dark gray SILT, 10% fine-grained sand, wet, moderate sweet odor.		
ss		50	3/4/4	0.0				6.0-7.5' ML: Gray to dark gray SILT, 15% clay, very thin lenses (2mm) of fine to medium-grained sand at 7.0', wet, trace mica flakes, trace wood fragments at 7.25', slight sweet odor.		
ss		24	2/3/3	0.0				7.5-9.0' SP: Gray to dark gray fine-grained SAND, <5% silt, silt pocket at 8.5', wet, trace mica flakes.		
ss		61	3/3/3	4.7				9.0-10.5' SP: Gray to dark gray fine-grained SAND, 15% silt, 1" thick silt lense at 9.25', silty sand lense at 9.75', wet, trace mica flakes, no odor.		

MW-16
2 of 2

ss		78	2/3/3	0.0		10.5-12.0' ML: Gray to dark gray SILT, 5% fine-grained sand, trace mica flakes, wet, no odor.	
ss	12-13.5	83	2/3/3	0.0		12.0-13.5' SP: Gray to dark gray fine to very fine-grained SAND, 10% silt, silt lense at 13-13.1' 1" thick, wet, 13.3-13.5' very wet with fine-grained subrounded gravel, very slight sweet odor to no odor.	
ss		72	2/3/4	0.0		13.5-15.0' SP: Gray to dark gray fine-grained SAND, 30% silt, sitl lense at 14.25-14.6', wet, trace mica flakes, no odor.	
ss		61	3/3/4	0.0		15.0-16.5' SP: Gray to dark gray, fine-grained SAND, 15% silt, silt lense at 15.25 and 16.3-16.45', wet, no odor.	
ss		72	3/5/6	0.0		16.5-18.0' ML: Gray to dark gray SILT, 5% fine-grained sand, fine-grained sand lense at 16.7 and 18.0', soft, wet, slight boggy odor and layer of organics at 17.75', no other odors.	
ss		72	3/4/4	0.0		18.0-19.5' ML: Gray SILT, <5% clay, very fine-grained sand and silt lense at 19.5', soft, wet, trace mica flakes.	

10 -10

15 -15

Bentonite used to backfill boring to desired depth.

Remarks and Datum Used:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sample Type	Groundwater		
N = SPT	Date	Time	Depth (ft.)
DP = Direct Push			
SS = Split Spoon			
C = Core			

MW-16 15

Sta 10 +75

beach by Central outfall

Boring/Well Log

RETEC

Well #: MW-17
Sheet 1 of 2

Project: SCE-TPH GW	Monument: Stick up	Stick Up: 6" steel protective casing
Project #: STRE1-18713-432	Northing: 724034.3 Easting: 1415655.3	Ground Elevation: 11.08
Location: OSM	Drill Rig Type: CME 75 rubber track rig	MP Elevation: 14.85
Client: Stoel Rives	Method: Hollow Stem Auger	Total Depth: 18'
Start Date & Time: 08/31/2005 0930	Casing ID: 2"	Filter Pack: 3.5-16.5' #10/20
Finish Date & Time: 08/31/2005 1130	Boring ID: 6.25"	Seal: 0.5-3.5' Bentonite chips
Contractor: Cascade	Bit Type: 6.25" HSA	Grout: -
Operator: Scott	Logged By: R. Knecht	Screen: 0.010-inch Slot Sch. 40 PVC 3.5-13.5'

Sample Type & #	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS)	Elevation (ft.)	Comments
ss		10	3/3/4	0.0			0	0.0-1.5' SP: Tan, black and white medium-grained SAND, little rocks, trace wood.	0	
ss		100	9/6/10	0.0				1.5-3.0' SP: Medium-grained SAND, no odor.		
ss		70	9/50/5"					3.0-4.5' SP: Medium-grained SAND, little rocks, one small cobble, slightly wet at bottom.		
ss	4.5-6.0	64	40/14/4	0.1			5	4.5-6.0' SP: Coarse-grained SAND, more black grains, 40% rocks, chuck of wood debris at bottom, large sheet of plastic at bottom, very wet, slight odor.	-5	
ss		83	3/3/3	0.0				6.0-7.5' SM: Dark gray SILTY SAND, slightly more sand grains at the bottom of section, very wet, slight biological odor at top, no odor.		
ss		100	3/3/3	0.0				7.5-9.0' SM: Dark gray to gray SILT and fine-grained SAND, fine-grained sand lense at 8.1', little silt at 8.5', wet, no odor.		
								9.0-9.5' ML: Gray to dark gray SILT, 35% fine-grained sand, wet, soft, no odor.		
ss		100	3/2/2	0.0			10	9.5-10.5' SP: Gray to dark gray fine-grained SAND, 25% silt, 15% fine-grained subangular gravel at 10.3', wet, no odor.	-10	

MW-17

2 of 2

ss		100	3/2/1	0.0		10.5-12.0' SP: Gray to dark gray fine-grained SAND, 20% silt, 5% fine-grained gravel at 11.25', silt lenses at 10.7-10.8', 11.4-11.5' and 11.75-12.0', trace mica flakes, wet, no odor.
ss	12.5-13.5	83	1/2/3	0.0		12.0-13.5' ML: Gray to dark gray SILT, 35% fine-grained SAND, increase in silt content going down section, pockets/lenses of fine-grained sand at 12.2, 12.8, 13.2 and 13.4, trace nodules of dense silt coarse-grained sand size, wet, no odor.
ss		100	2/3/4	0.1	15	13.5-15.0' SP: Gray to dark gray fine-grained SAND, 25-30% silt, wood piece found at 13.8 and 14.75' sitting vertical in hole approximately 3" long, wet, no odor.
ss		100	3/4/4	0.0		15.0-16.5' SP: Gray to dark gray fine-grained SAND, 15% silt, silt at 15-15.5', wood pieces at 15.8' fine-grained gravel size, wet, no odor, trace mica flakes.
ss	17.5-18	100	4/5/5	0.0		16.5-17.7' SP: Dark gray fine-grained SAND, 15-20% silt, wet, no odor, trace mica flakes. 17.7-18.0' ML: Dark gray SILT, 5% fine-grained sand, medium stiff, wet, no odor.

-15

Bentonite used to backfill boring to desired depth.

Remarks and Datum Used:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)

Sta 5+25

beach - North end of remedy area

RETEC

Boring/Well Log

Well #: MW-18
Sheet 1 of 2

Project: SCE-Metals	Monument: Stick up	Stick Up: 6" steel protective casing
Project #: STRE1-18713-410	Northing: 724531.7 Easting: 1415870.5	Ground Elevation: 11.39
Location: OSM	Drill Rig Type: CME 75 rubber track rig	MP Elevation: 14.74
Client: Stoel Rives	Method: Hollow Stem Auger	Total Depth: 14'
Start Date & Time: 08/30/2005 1125	Casing ID: 2"	Filter Pack: 3.5-14' #10/20
Finish Date & Time: 08/30/2005 1345	Boring ID: 6.25"	Seal: 0.5-3.5' Bentonite chips
Contractor: Cascade	Bit Type: 6.25" HSA	Grout: -
Operator: Scott	Logged By: R. Knecht	Screen: 0.010-inch Slot Sch. 40 PVC 4-14'

Sample Type & #	Depth Range	% Rec	Blows per 6"	PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS)	Elevation (ft.)	Comments
							0		0	
ss		61	10/9/8	0.0				0.0-0.5' SP: Dark brown coarse-grained SAND, 35% fine grained gravel, 15% fine-grained rounded gravel, dry.		
								0.5-1.5' SP: Light brown to brown medium-grained SAND, 5% coarse-grained rounded gravel, 20% coarse-grained sand and fine-grained gravel, dry.		
ss		55	9/10/10	0.0				1.5-3.0' SW: Slight gray brown fine to medium-grained SAND, 15-20% fine-grained subrounded to rounded gravel, dry.		
ss		20	11/16/9	0.0				3.0-4.5' SW: Brown fine to medium-grained SAND, 15% fine-grained gravel, moist, large cobble in bottom of spoon.		
ss		20	7/5/5	0.0			5	4.5-6.25' SP: Brown fine-grianed SAND, 20% medium-grained sand, 20% nodules of silty fine-grained sand, 5% fine-grained subrounded to rounded gravel, damp.	-5	
ss		83	1/2/2	0.0				6.25-7.0' SP: Gray to light gray with red mottles fine-grained SAND, 30% silt, wet, no odor.		

MW-18

292

ss		90	1/1/1	1.4	7.0-7.5' ML: Gray with red mottles SILT, 10% fine-grained sand, wet, trace rootlets.	
					7.5-8.0' SM: Gray with red mottles fine-grained SAND and SILT, at 7.7' cobble 1" thick, wet, no odor.	
					8.0-8.25' SP: Gray with red mottles fine-grianed SAND, wet, no odor.	
					8.25-9.0' ML: Gray with red mottled SILT, 20% fine-grained sand, wet, no odor.	
					9.0-9.25' SP: Grayish brown fine-grianed SAND, 10% subangular fine-grained gravel, wet, no odor.	
					9.25-9.5' ML: Gray SILT, 30% fine-grained sand, trace rootlets.	
ss		100	1/2/2	0.0	9.5-10.5' SP: Gray with red rusting color mottled fine-grained SAND, 10% silt, wet, soft, no odor, trace mica flakes.	
						-10
					10.5-11.75' SP: Gray with red mottles fine-grained SAND, 20% silt, lenses of more silt content in sand, wet.	
ss		100	1/3/4	0.0		
					11.75-12.0' SP: Dark gray with red mottles fine-grained SAND, wet, trace mica flakes.	
					12.0-13.5' SP: Gray to dark gray fine-grained SAND, wet, no odor, trace mica flakes.	
ss	12-13.5	90	2/2/2	0.0		
					13.5-15.0' SP: Gray to dark gray fine-grained SAND, 15% silt, wet, no odor.	
ss		100	1/2/3	0.4		
						-15

10

15

Boring drilled only to 14 feet bgs split spoon taken from 13.5 to 15 feet bgs.

Remarks and Datum Used:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)

sta 1 +50

beach-for North end

Boring/Well Log

Well #: MW-19
Sheet 1 of 2

Project: SCE-Metals	Monument: Stick up	Stick Up: 6" steel protective casing
Project #: STRE1-18713-410	Northing: 724817.1 Easting: 1416857.4	Ground Elevation: 11.39
Location: OSM	Drill Rig Type: CME 75 rubber track rig	MP Elevation: 14.60
Client: Stoel Rives	Method: Hollow Stem Auger	Total Depth: 15'
Start Date & Time: 08/30/2005 0745	Casing ID: 2"	Filler Pack: 3.5-15' #10/20
Finish Date & Time: 08/30/2005 0920	Boring ID: 6.25"	Seal: 0.5-3.5' Bentonite chips
Contractor: Cascade	Bit Type: 6.25" HSA	Grout: -
Operator: Scott	Logged By: R. Knecht	Screen: 0.010-inch Slot Sch. 40 PVC 4-14'

Sample Type & #	Depth Range	% Rec	Blows per 6"	PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS)	Elevation (ft.)	Comments
							0		0	
ss		55	5/6/6	0.0				0.0-0.5' SP: Brown medium-grained SAND, 20% rounded fine to coarse-grained gravel, trace wood pieces.		
								0.5-1.5' ML: Red brown with gray mottles SILT, 10% clay, few rootlets, moist, hard, friable.		
ss		40	5/6/7	0.0				1.5-3.0' ML: Reddish brown with reddish staining around gray mottles SILT, some fine-grained sand lense, 5% clay, few blackspots, soil in laminated layers.		
ss		33	4/6/4	0.0				3.0-4.5' ML: Reddish brown SILT, 20% fine-grained sand, 5% clay, <5% gray layers 1mm thick laminations, 10% fine to coarse-grained subangular to subrounded gravel, moist.		
								4.5-6.0' SM: Reddish brown to brown SILT and fine-grained SAND, 5% clay, moist, no odor.		
ss		20	2/3/3	0.0			5		-5	
								6.0-7.5' SC: Gray with red mottles SANDY CLAY, fine-grianed sand, wet, soft.		
ss		83	1/2/1	0.0						

MW-19
2 of 2

ss				0.0		7.5-9.0' ML: Gray with red mottles SILT, 20% clay, fine-grained sand lense 1" thick at 8.5' and 8.75', wet, few mica flakes.
ss		100	3/4/5	0.0	10	9.0-10.5' SP: Gray brown fine-grained SAND, 30% silt, few red mottles, silt lense at 10.25' 1/2" thick, wet.
ss		100	2/3/3	0.0		10.5-12.0' SP: Gray fine-grained SAND, 30% silt, few burnt red mottles at 10.25-10.35', wet.
ss	12-13.5	100	2/2/2	0.0		12.0-13.5' SP: Gray fine-grained SAND, 30% silt, lenses of clayey silt at 12.5-12.9', wet.
ss		100	2/2/2		15	13.5-15.0' ML: Gray SILT, 10% fine-grained sand and mica, wet, soft, no odor.

-10

-15

Remarks and Datum Used:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)

NOT ON BANK

Near east landfill upgradient

Boring/Well Log

RETEC

Well #: MW-20
Sheet 1 of 2

Project: SCE-Metals	Monument: Stick up	Stick Up: 6" steel protective casing
Project #: STRE1-18713-410	Northing: 724396.8 Easting: 1417344.0	Ground Elevation: 33.77
Location: OSM	Drill Rig Type: CME 75 rubber track rig	MP Elevation: 37.10
Client: Stoel Rives	Method: Hollow Stem Auger	Total Depth: 14'
Start Date & Time: 09/06/2005 1324	Casing ID: 2"	Filter Pack: 4-14' #10/20
Finish Date & Time: 09/06/2005 1440	Boring ID: 6.25"	Seal: 1-4' Bentonite chips
Contractor: Cascade	Bit Type: 6.25" HSA	Grout: -
Operator: Scott	Logged By: R. Knecht	Screen: 0.010-Inch Slot Sch. 40 PVC 5-14'

Sample Type & #	Depth Range	% Rec	Blows per 6"	PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS)	Elevation (ft.)	Comments
							0		0	
ss		100	50/5"	1.9				0.0-0.5' GP: Light gray to black fine-grained subrounded to subangular GRAVEL, 30% coarse-grained sand, 10% fine-grained sand and silt, dry, no odor, asphalt like material at 0.5'.		
								0.5-1.5' No recovery.		
								1.5-2.0' GP: Dark gray coarse-grained SAND and fine-grained subangular to subrounded GRAVEL, 20% fine-grained sand, dry, no odor.		
ss		100	50/6"	2.1				2.0-3.0' No recovery.		
								3.0-3.1' SP: Dark gray coarse-grained SAND, 30% fine-grianed sand, dry, no odor.		
								3.1-3.5' SP: Light yellowish brown medium-grained SAND, 10% coarse-grained sand and fine-grained sand, moist, no odor.		
ss		100	50/6"	0.9				3.5-4.5' No recovery.		
								4.5-5.0' GP: Dark gray to black fine-grained subrounded to subangular GRAVEL, 20% medium-grained sand, moist, no odor.		
ss		100	50/4"	1.1			5	5.0-6.0' No recovery.	-5	
								6.0-7.5' GP: Dark gray subangular fine-grained GRAVEL, 10% coarse-grained subangular gravel, 5% fine to medium-grained sand, <5% silt, moist to wet.		
ss		55	18/35 /40	5.6						

MW-20
292

SS		100	50/2"	2.1			7.5-7.75' SP: Dark grayish brown fine-grained subangular GRAVEL and medium to coarse-grained SAND, 10% fine-grained sand, <5% coarse-grained subangular gravel, wet except in shoe damp in shoe, no odor. 7.75-9.0' No recovery.
SS		40	18/20 /23	2.2		10	9.0-10.5' GP: Dark gray fine-grained subangular GRAVEL and coarse-grained SAND, <5% fine-grained sand and coarse-grained subangular gravel,10% medium-grained sand, wet, no odor, no sheen. 10.5-11.0' Dark brownish gray fine-grained angular to subangular GRAVEL, 40% coarse-grained sand, <5% medium-grained sand and coarse-grained subangular gravel, wet, no odor, no sheen.
SS		100	50/6"	2.4			11.0-12.0' No recovery.
SS	12-13.5	100	28/ 50/6"	1.1			12.0-12.6' GP: Dark gray to gray coarse-grained SAND and fine-grained subangular to angular GRAVEL, gravel 1/2" to 1/4" in diameter, <5% silt and fine-grained sand, 10% medium-grained sand, wet, no odor. 12.6-13.5' No recovery. 13.5-14.0' Dark gray to gray coarse-grained SAND and fine-grained subangular to angular GRAVEL, 1/2" to 1/4" in diameter, <5% silt, 10% medium-grained sand, wet, no odor, no sheen.

-10

Remarks and Datum Used: PID readings: no odor but lots of moisture.

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)

upland ~ Sta 17+75

behind water treatment bldg

Boring/Well Log

RETEC

Well #: MW-21
Sheet 1 of 2

Project: SCE-TPH GW	Monument: Flush mount steel road box	Stick Up: -
Project #: STRE1-18713-410	Northing: 723307.2 Easting: 1415717.5	Ground Elevation: 33
Location: OSM	Drill Rig Type: CME 75 rubber track rig	MP Elevation: 32.73
Client: Stoel Rives	Method: Hollow Stem Auger	Total Depth: 21'
Start Date & Time: 09/07/2005 0730	Casing ID: 2"	Filter Pack: 5-21' #10/20
Finish Date & Time: 09/07/2005 0930	Boring ID: 6.25"	Seal: 1-5' Bentonite chips
Contractor: Cascade	Bit Type: 6.25" HSA	Grout: -
Operator: Scott	Logged By: R. Knecht	Screen: 0.010-inch Slot Sch. 40 PVC 6-21'

Sample Type & #	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft)	Soil and Rock Description (Classification Scheme: USCS)	Elevation (ft.)	Comments
ss		83	18/20 /23	5.7			0	0.0-0.5' SW: Brown to dark brown medium to coarse-grained SAND, 40% fine-grained subangular gravel, large wood fragments on top, damp.	0	
								0.5-1.5' SP: Brown to dark brown medium-grained SAND, 15% fine-grained sand, <5% silt, <5% sticky clay at 1.4-1.5', no odor.		
ss		90	23/ 50/5"	17.2				1.5-3.0' SP: Very dark brown to black, fine-grained SAND, 15% medium-grained sand, <5% coarse-grained sand, <5% fine-grained subangular gravel at 2.3-2.5, damp, staining gloves, burnt fuel like odor at 2.25-2.5'.		
ss		83	25/35 /38	2.9				3.0-4.5' SP: Very dark brown to black medium-grained SAND, 15% fine-grained sand, 5% coarse-grained sand, bentonite found in half of split spoon from 3.5-4.5', damp to dry, burnt fuel like odor, staining gloves black.		
ss		77	18/25 /30	8.3			5	4.5-5.25' SP: Very dark brown to black medium-grained SAND, 15% fine-grained sand, 5% coarse-grained sand, small pockets of fine-grained sand at 5.0', bentonite on side of split spoon, moist, burnt fuel like odor, stains gloves black.	-5	
								5.25-6.0' SP: Gray to dark gray fine-grained SAND, 10% medium-grained sand, hard, moist to wet at bottom, sharp contact, chemical odor, gloves not stained, bentonite on side of split spoon.		
ss		67	13/14 /18	543				6.0-7.5' SP: Gray medium-grained SAND, 30-40% fine-grained sand, moist to wet, 5% white ashy material at 6.75-7.5', moderate chemical odor, no staining or free product.		
ss		88	6/7/8	81.4				7.5-8.5' SP: Gray to dark gray fine-grained SAND, 10% white flakes throughout, 5-10% medium-grained sand, moist, slight bitter chemical odor, no staining on gloves.		
								8.5-8.9' ML: Gray SILT, 10-15% fine-grained sand, wet, very slight chemical odor, no staining on gloves.		
ss		88	6/7/8	279			10	8.9-9.0' SP: Gray to dark gray fine-grained SAND, 5-10% medium-grained sand, 10% white flakes (quartz, calcite) throughout, wet, moderate to strong TPH like odor.	-10	

MW-21
292

ss		83	6/5/4	273		9.0-10.5' SP: Gray fine-grained SAND, 10% medium-grained sand, <5% quartz and calcite, wet to moist, strong to moderate TPH like odor, gloves staining translence brown.
						10.5-12.0' SP: Gray fine-grained SAND, 10% medium-grained sand, large wood chunk at 11.25' 3" long, little organics (rootlets, wood) from 10.75 to 12', wet to moist, strong TPH like odor, slight staining on gloves.
ss		80	8/6/6	442		12.0-13.5' SP: Gray fine-grained SAND, 5% medium-grained sand, wet, 1/2" wood layer at 12.25', strong TPH like odor, very heavy sheen, staining gloves transluenct brown yellow, no blebs of free product.
ss		88	8/7/6	577		13.5-15.0' SP: Gray fine-grained SAND, 5% medium-grained sand, wood fragment at 13.75', wet, strong TPH like odor, sheen on water, staining gloves, trace mica and quartz.
					15	-15
ss		94	5/6/7	450		15.0-18.0' SP: Gray fine-grained SAND, 5-10% medium-grained sand, wet, strong TPH like odor, staining gloves transluenct brown, blebs of product in pore spaces, slight sheen on water, wood fragment at 16.8'.
ss		100	6/7/7	409		
ss	18-19.5	88	7/8/10	384		18.0-19.5' SP: Gray fine-grained SAND, 5-10% medium-grained sand, at 18.4' silt content at 20% for 2", wet, sheen on water, blebs of product, 18.4-18.5' organics present, moderate TPH like odor, product in pore spaces.
						19.5-21.0' SP: Gray fine-grained SAND, 5-10% medium-grained sand, <5% quartz and calcite crystals, wet, slight sheen, moderate TPH like odor to 20.25', slight TPH like odor to 21', blebs of product at 19.5-20'.
ss		94	9/10 /10	550	20	-20

Remarks and Datum Used: Sheen seen on decontamination bucket water.

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)

Sta 14+25

beach - North of Dock

Boring/Well Log

RETEC

Well #: MW-23
Sheet 1 of 2

Project: SCE-TPH GW	Monument: Stick up	Stick Up: 6" steel protective casing
Project #: STRE1-18713-432	Northing: 723736.8 Easting: 1415533.6	Ground Elevation: 11.02
Location: OSM	Drill Rig Type: CME 75 rubber track rig	MP Elevation: 14.48
Client: Stoel Rives	Method: Hollow Stem Auger	Total Depth: 15'
Start Date & Time: 08/31/2005 1455	Casing ID: 2"	Filter Pack: 3.5-13.5' #10/20
Finish Date & Time: 08/31/2005 1630	Boring ID: 6.25"	Seal: 0.5-3.5' Bentonite chips
Contractor: Cascade	Bit Type: 6.25" HSA	Grout: -
Operator: Scott	Logged By: R. Knecht	Screen: 0.010-inch Slot Sch. 40 PVC 3.5-13.5'

Sample Type & #	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS)	Elevation (ft.)	Comments
ss		72	2/2/3	0.0			0	0.0-1.5' SP: Tan to light brown medium-grained SAND, 15% coarse-grained sand, 5% fine-grained rounded gravel, damp, few rootlets and wood fragments.	0	
ss		100	8/10/10	0.0				1.5-2.7' SP: Tan to light brown medium-grained SAND, 15% coarse-grained sand, 5% fine and coarse-grained rounded gravel, damp, few rootlets and wood fragments.		
ss		33	15/18/6	0.0				2.7-3.0' SW: Brown, fine to medium-grained SAND, 5% fine-grained gravel, damp, no odor.		
ss	5.1-5.5	61	6/5/2	0.0			5	3.0-4.5' SW: Brown fine to medium-grained SAND, 10% fine-grained subrounded to rounded gravel.	-5	
								4.5-5.0' SW: Brown fine to medium-grained SAND, 5% coarse-grained sand and fine-grained gravel, wet, no odor.		
								5.0-5.1' WOOD.		
ss		100	3/4/5	0.0				5.1-5.5' GP: Dark brown fine to medium-grained angular to subangular GRAVEL, 20% fine-grained sand and silt, wet, free water.		
								5.5-6.0' ML-CL: Dark gray CLAY and SILT, 5% fine-grained subangular gravel, wet.		
ss		100	2/2/3	0.0				6.0-7.0' ML: Dark gray SILT, 15-25% fine-grained sand, wet, trace mica flakes, no odor.		
								7.0-7.5' SP: Dark gray fine-grained SAND, 5% silt, wet, trace mica flakes, no odor.		
ss		100	4/5/5	0.0				7.5-9.0' SP: Dark gray fine-grained SAND, 5% silt, lense of silt at 8.8-8.9', wet, trace mica flakes, no odor.		
							10	9.0-10.5' SP: Dark gray fine-grianed SAND, 5-10% silt, some silt in concentrated pockets, wet, trace mica flakes, no odor.	-10	
ss	10.5-12	100	5/6/6	0.4				10.5-12.0' SP: Dark gray fine-grianed SAND, 20-25% silt, less silt content down section, 5-10% silt at 11.5-12', wet, no odor.		
								12.0-13.5' SP: Dark gray fine-grained SAND, <5% silt, wet, trace mica flakes, no odor.		
ss		69	4/4/5	0.0						

MW-23
2 of 2

ss		78	4/4/5	0.2		15	13.5-15.0' SP: Dark gray fine-grianed SAND, 10-15% silt, higher silt content at 13.5-13.75', wet, trace mica flakes, no odor.	-15

Boring drilled only to 13.5 feet bgs split spoon taken from 13.5 to 15 feet bgs.

Remarks and Datum Used:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)

ATTACHMENT B

Riverbank Photos


WARNING

ATTACHMENT C - SEISMIC DESIGN

A. Pages from Geotechnical Investigation
Oregon Steel Mills New Pipe Mill

Jun. 2005

GEOCON INC

B. USGS MAP - Peak Ground Acceleration with a 10% probability of Exceedance in 50 years.

MB

GEOTECHNICAL INVESTIGATION

OREGON STEEL MILLS
NEW PIPE MILL

PORTLAND, OREGON

GEOCON
INCORPORATED
GEOTECHNICAL
CONSULTANTS

PREPARED FOR

OREGON STEEL MILLS
PORTLAND, OREGON

JANUARY 2005

ATTACHMENT C

dense. Existing groundwater monitoring wells on the Oregon Steel Mills property indicate that the groundwater surface is present within this deposit at a depth of approximately 15 feet bgs.

CLAYEY SILT– In general, a soft to medium stiff, moist to wet, olive gray to gray clayey silt to silty clay with varied amounts of fine-grained sand was encountered below the dredged sand to depths ranging from 55 to 85 feet below ground surface. The clayey silt and silty clay have Liquid Limit values of 38 and 57 and Plastic Limit values of 34 and 32, respectively. Existing moisture contents generally ranged from 45 to 70 percent. Consolidation tests and in-situ testing indicate the deposit is slightly overconsolidated and moderately compressible under anticipated floor loads and foundation loads. Deep foundation systems to mitigate excessive settlement are discussed in following sections of this report.

SILTY SAND – The clayey silt to silty clay is underlain by dense silty sand to depths ranging from 174 to 190 feet bgs. SPT blowcounts greater than 30 and cone tip resistances above 50 tsf characterize this material. An additional layer of fine sandy silt was delineated in the cone penetration data (CPT-2) between 120 and 140 feet bgs.

GRAVEL – Very dense gravel was encountered below the silty sand at depths ranging from 174 feet bgs in the central and east portions of the site to 190 feet bgs in the west boundary.

GROUNDWATER – Groundwater has been observed in existing monitoring wells on the Oregon Steel Mills property at approximately 15 feet below the existing ground surface. The groundwater surface may fluctuate depending on time of year and during prolonged periods of wet weather but is generally expected to be near the surface elevation of the adjacent Willamette River.

Subsurface conditions encountered during the field investigation appear to be consistent with geologic conditions mapped within the region. Exploration logs documenting the subsurface conditions encountered are presented in Appendix A at the end of this report. Generalized subsurface conditions are illustrated in Figures 3 and 4.

5 SEISMIC HAZARDS

5.1 Landslide Hazard

Due to the relatively flat topography and absence of steep slopes across the site, the landslide hazard is considered negligible.

5.2 Crustal Faults

Based on the literature review, there are no identified faults mapped within the boundaries of the site or within adjacent properties. Evidence was not encountered during the field investigation to suggest the presence of faults within the property. The potential for fault displacement and associated ground subsidence at the site is considered remote.

5.3 Ground Shaking Characteristics

Several methods of analysis were used to evaluate the characteristics of ground shaking that could occur at the site from various earthquake sources. Both probabilistic and deterministic methods of evaluation were used in this study.

5.3.1 Probabilistic Evaluation

Several studies have been published which present probability-based levels of ground motion for Western Oregon. Studies reviewed for this report include Geomatrix (1995) United States Geological Survey (2002), and Wong et al (2000). These probabilistic studies incorporate the seismic characteristics of faults and seismic zones, including fault location and geometry, slip rate, and magnitude, to develop estimates of ground or bedrock shaking for different return periods (or probability of exceedance at different time periods). Within Western Oregon large uncertainties exist in probabilistic analyses due to the lack of significant historical seismicity and the uncertainty associated with seismic source characterization.

The study by Geomatrix (1995) estimated peak bedrock horizontal accelerations in the site vicinity of 0.19g, 0.27g, and 0.37g for return periods of approximately 500 years, 1,000 years, and 2,500 years, respectively. These return periods correlate to probabilities of exceedance of 10%, 5%, and 2% in 50 years, respectively.

The United States Geological Survey "National Seismic Hazard Mapping Project" (2002) estimated peak bedrock horizontal accelerations of 0.19g and 0.41g for return periods of approximately 500 and 2,500 years, respectively.

5.3.2 Deterministic Evaluation

Another method of evaluating potential ground motions is known as deterministic analysis. This process consists of identifying specific faults, their magnitude, and their distance to the site. Attenuation relationships are then used to evaluate the ground motion parameter(s) of interest (typically peak bedrock acceleration) at the site. The attenuation relationships used have been developed for site to source distances greater than or equal to the vertical distance from the ground surface to the top of the seismogenic part of the earth's crust (Campbell, 1997). This distance

was assumed to be greater than five kilometers for Western Oregon. For soil sites the peak acceleration can be determined from attenuation relationships developed for soil sites or from dynamic site response analyses. The majority of attenuation relationships are based on observed data (i.e. empirical) from previous earthquakes.

The potential bedrock acceleration at the site was determined for the faults described in Section 5.1.1. Attenuation relationships developed by Campbell (1997), Boore et al (1997), and Abrahamson and Silva (1997) were used to estimate the bedrock acceleration from crustal faults. Bedrock accelerations from intraslab and subduction zone earthquakes were evaluated with the attenuation relationship developed by Youngs et al (1997). Table 2 presents the results of the attenuation analysis. It is important to note that no recurrence interval or return period is associated with these accelerations.

5.3.3 Design Ground Shaking Parameters

It is understood that the building will be designed in accordance with the 2003 International Building Code (IBC). A soil characteristic called "Soil Profile Type" is used to account for the effect of the underlying soil conditions on bedrock motion for the IBC. Based on the subsurface conditions encountered during the field investigation in conjunction with the geological literature reviewed for the site, it is recommended that the IBC seismic factors and coefficients given in Table 3 at the end of this report be used for seismic design.

5.4 Soil Liquefaction Potential

Liquefaction can cause aerial and differential settlement, lateral spreading, and sudden loss of soil shear strength. Soils prone to liquefaction are typically loose, saturated sands and soft silt. Liquefaction susceptible soils typically consist of geologically young alluvial deposits and man-made fills. When ground shaking, due to earthquake loading commences, the loose, saturated soils tend to contract, which results in the generation of excess pore-water pressures. The degree of excess pore-water pressure generation is largely a function of the magnitude and duration of the ground shaking, as well as the density of the soil.

Liquefaction analyses consist of computing the cyclic shear stresses induced in the soil by seismic shaking and calculating the cyclic shear strength (resistance) of the soil which is available to resist the seismic loading. Comparison of the soil shear strength to the induced seismic shear stress determines the susceptibility of the underlying soil to liquefaction or shear strength loss. The soils at the subject site were evaluated for liquefaction potential in accordance with the procedures presented in NCEER, 1997.

The undrained cyclic shear strength of the soil defines the capacity of the soil to resist the earthquake-induced shear stresses. Empirical relationships, based on historical field observations, are generally used to assess the soil shear strength. Various field investigation tests can be used to determine the soil shear strength including standard penetration tests (SPT), cone penetrometer tests (CPT), and shear wave velocity. Geocon Northwest prefers CPT data because the cone penetration test provides a continuous record of penetration resistance throughout the soil deposit, which provides a better description of soil variability. This is particularly important in sands and silts because of the natural non-uniformity of these deposits. Standard penetration and cone penetration test results from the site field investigation were both used to evaluate the cyclic shear resistance of the subsurface soils.

The liquefaction susceptibility of the underlying soils was evaluated using ground motions from a magnitude 6.0 crustal earthquake source with peak ground acceleration (PGA) of 0.3g, a magnitude 7.0 instraslab earthquake source with PGA of 0.19g, and a magnitude 8.5 subduction zone source with PGA of 0.12g. The crustal source analysis is representative of ground shaking associated with the 2003 IBC specifications, while the intraslab event has accelerations consistent with the probabilistic study provided by the United States Geologic Survey's National Seismic Hazard Mapping Project for a 500-year return period.

Based on the results of our analyses, liquefaction at the site is possible within lenses between the depths of approximately 20 to 35 feet. Limited dynamic settlement of the liquefaction zone will occur after earthquake shaking has ceased. Estimated dynamic settlements were evaluated using the methodologies developed by Seed and Tokimatsu (1987) and Ishihara and Yoshimine (1992). The results of the analysis indicate settlement of one to two inches may occur due to the design level earthquake loading.

5.5 Lateral Spreading

Lateral spreading is a liquefaction related seismic hazard that may adversely impact some sites. Areas subject to lateral spreading are underlain by liquefiable sediments and are sites that slope or are flat sites adjacent to an open face. Current plans locate the proposed pipe mill approximately 200 feet east of the bank of the Willamette River. The presence of liquefiable lenses provides the potential for lateral spreading at the site. The lateral spreading analysis was completed using the procedure developed by Bartlett and Youd (2002). The results of the analysis

indicate minor lateral spreading of one to two inches may occur due to the design level earthquake loading.

5.6 Seiche and Tsunami Inundation

There is not a potential for tsunami-related damage at the site due to the distance of the site from coastal areas. The potential for seiche-related damage is considered low due to the limited width of the Willamette River perpendicular to the site and elevation differential above the river.

6 LABORATORY TESTING

Laboratory testing was performed on selected soil samples to evaluate moisture content, plasticity, gradation, and consolidation characteristics. Visual soil classification was performed both in the field and laboratory, in general accordance with the Unified Soil Classification System. Moisture content determinations (ASTM D2216) were performed on soil samples to aid in classifying the soil. Grain size analyses were performed on selected samples using procedures ASTM D1140 and ASTM D422. Consolidation characteristics were obtained using ASTM D 2435. Moisture contents are indicated on the boring logs and are located in Appendix A of this report. Other laboratory test results for this project are summarized in Appendix B.

7 DISCUSSION

The site is underlain by compressible (silt and clay) and liquefiable (silty sand) soils that will undergo settlement if subjected to significant floor, foundation, or seismic loads. The compressible clayey silt to silty clay soil averages approximately 30 feet thick and is characterized by moderately plastic silt and clay with moisture contents at or above the liquid limit. Laboratory consolidation testing, and the results of the CPT and DMT soundings, indicate that the clayey silt to silty clay soil would experience unacceptable settlements if subjected to proposed design loads.

A pile foundation system, consisting of driven steel pipe piles or driven grout piles that extend into the underlying dense sands, could be used to support the building loads and floor loads (i.e. structural slab) and resist potential damage due to liquefaction or lateral spreading. It may be possible, depending on the final design floor loads, to support the slab using a more economical ground improvement method such as Geopiers. Geocon Northwest should be contacted to evaluate the feasibility of alternative slab support mechanisms as final design loads are available. It should be noted that the Geopier installation process produces spoils and is not recommended for installation below the groundwater surface.

Table 1: Crustal Faults

Mapped Fault or Fault Zone	*Probability of Activity (Wong, 2000)*	*Fault Type (Geomatrix, 1995)*	*Maximum Moment Magnitude (Wong, 2000)*	*Approx. Horizontal Distance From Site to Surface Fault Trace (miles)*
Portland Hills Fault	0.8	Strike-slip (1)	6.8	5
Bolton Fault	0.2	Reverse (1)	6.3	20
Grant Butte, Damascus-Tickle Creek Fault Zone	0.5	Lateral slip (1)	6.4	17
Helvetia Fault	0.2	Reverse (1)	6.3	12
Lacamas Lake Fault	0.5	Strike-slip, Oblique-slip (1)	6.5	9
Sandy River Fault	0.1	Dip-slip, Strike-slip (1)	6.4	24
Mount Angel Fault	0.9	Strike-slip (1)	6.6	36
Newberg Fault	0.7	Strike-slip (1)	6.2	26
Gales Creek Fault	0.7	Strike-slip (1)	6.4	27

Table 2: Attenuation Derived Peak Bedrock Acceleration

Fault	*Distance (miles)*	*Magnitude*	*Bedrock Acceleration (g)*		
			Campbell (1997)	*Boore et al (1997)*	*Abrahamson and Silva (1997)*
Portland Hills Fault	5 (1)	6.8	0.38	0.42	0.42
Bolton Fault	20 (1)	6.3	0.06	0.13	0.09
Grant Butte, Damascus-Tickle Creek Fault Zone	17 (1)	6.4	0.08	0.15	0.12
Helvetia Fault	12 (1)	6.3	0.12	0.19	0.16
Lacamas Lake Fault	9 (1)	6.5	0.20	0.25	0.23
Sandy River Fault	24 (1)	6.4	0.05	0.12	0.08
Mount Angel Fault	36 (1)	6.6	0.03	0.09	0.06
Newberg Fault	26 (1)	6.2	0.04	0.10	0.06
Gales Creek Fault	27 (1)	6.4	0.04	0.11	0.07
Intraslab	20 (2)	7.0	0.19 (3)		
Cascadia Subduction Zone	60 (2)	8.5	0.11 (3)		

(1) Epicenter Distance

(2) Focal Distance

(3) Youngs et al (1997)

Table 3: 2003 IBC Seismic Design Recommendations

Seismic Variable	*Recommended Value*
Site Class	D
MCE short period spectral response accel., S_{MS}	1.14
MCE 1-second period spectral response accel., S_{M1}	0.61
5% damped short period spectral response accel., S_{DS}	0.76
5% damped 1-second period spectral response accel., S_{D1}	0.41

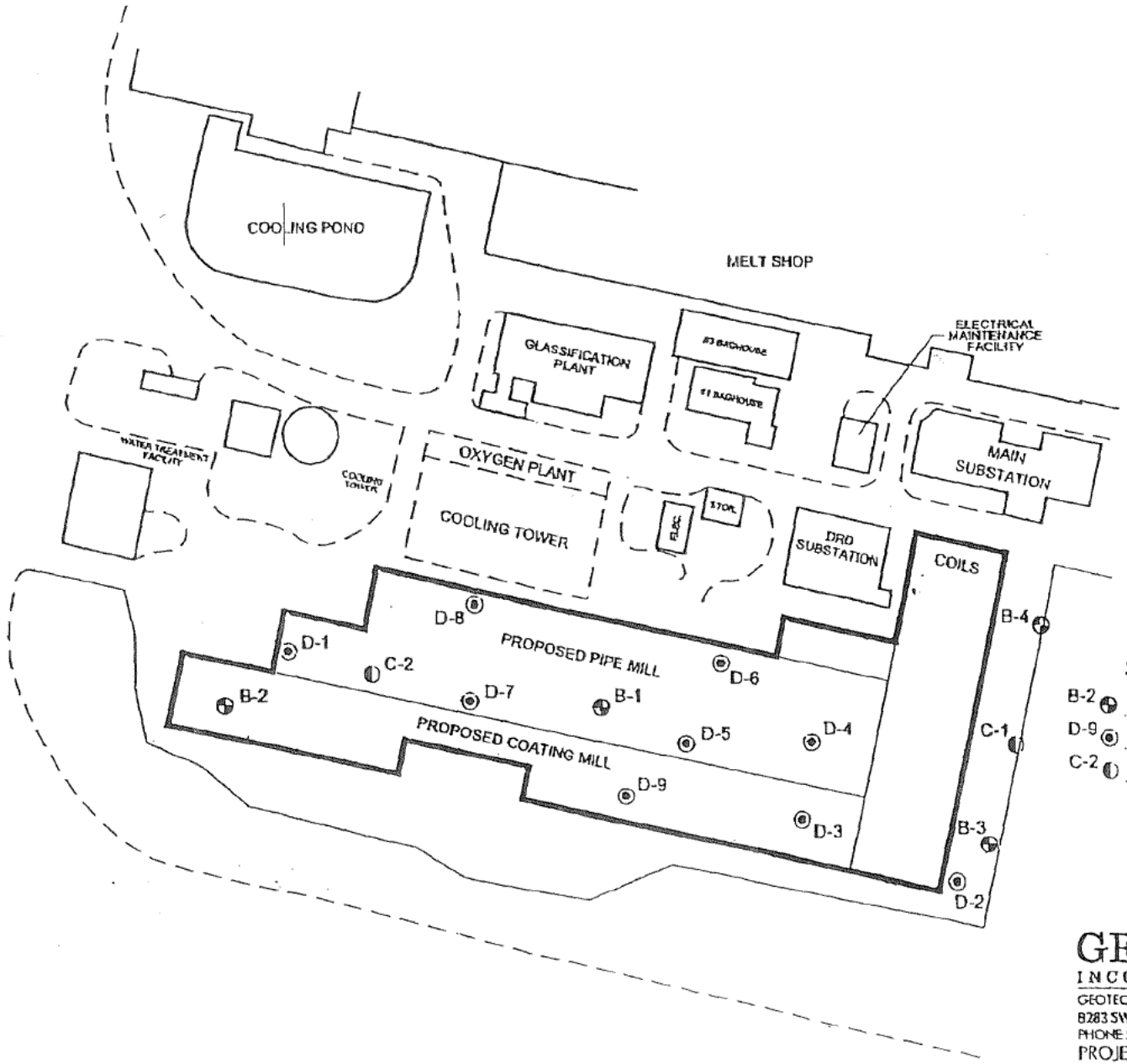
Table 4: Asphalt Concrete Pavement Design

Approximate Number of Trucks per Day (each way)	*Approximate Number of 18 Kip Design Axle Load (1000)*	*Asphalt Concrete Thickness (inches)*	*Crushed Rock Base Thickness (inches)*
Auto Parking	10	2.5	8
5	22	3.0	8
10	44	3.0	10
15	66	3.5	10
25	110	4.0	10
50	220	4.0	12
100	440	4.5	12
150	660	5.0	13

Table 5: Portland Cement Concrete Pavement Design

Approximate Number of Trucks per Day (each way)	*Approximate Number of 18 Kip Design Axle Load (1000)*	*P.C.C. Thickness (inches)*	*Crushed Rock Base Thickness (inches)*
25	110	6.0	6
50	220	7.0	6
100	440	8.0	6
150	660	8.5	6
200	880	8.5	6
250	1100	9.0	6

OREGON STEEL MILLS
PORTLAND, OREGON



GEOCON LEGEND

B-2 ..... APPROX. LOCATION OF BORING
D-9 ..... APPROX. LOCATION OF DILATOMETER
C-2 ..... APPROX. LOCATION OF CONE PENETROMETER

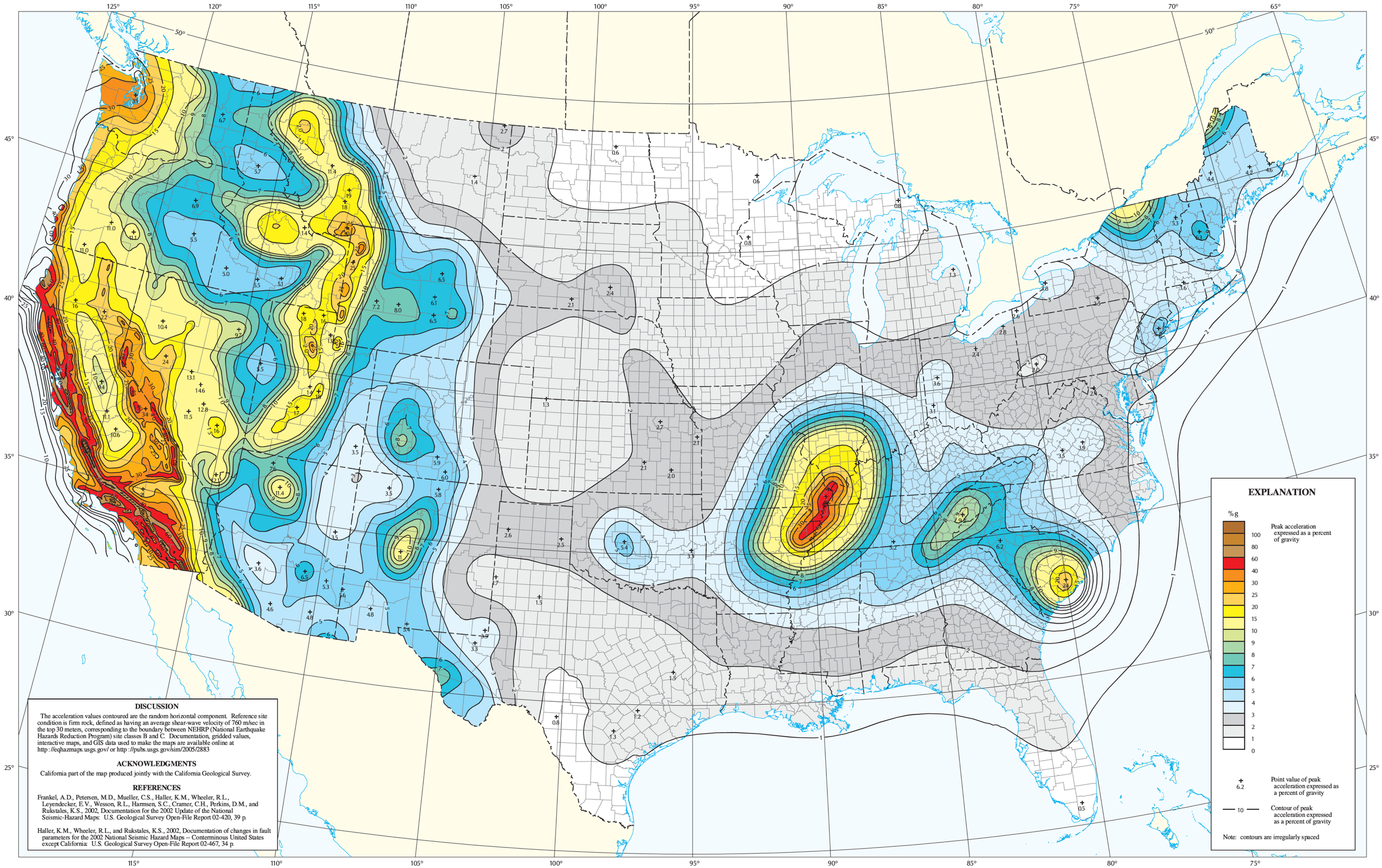
SITE PLAN

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
8283 SW CIRRUS DRIVE - BEAVERTON, OREGON 97008-6443
PHONE 503 626-9889 - FAX 503 626-8611

PROJECT NO. P1297 - 05 - 01
FIGURE 2
DATE 1/7/2005

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

SCIENTIFIC INVESTIGATIONS MAP 2883
SHEET 1 OF 6
Version 1.0



EXPLANATION

%g

100	Peak acceleration expressed as a percent of gravity
80	
60	
40	
30	
25	
20	
15	
10	
9	
8	
7	
6	
5	
4	
3	
2	
1	
0	
+ 6.2	Point value of peak acceleration expressed as a percent of gravity
— 10 —	Contour of peak acceleration expressed as a percent of gravity

Note: contours are irregularly spaced

DISCUSSION

The acceleration values contoured are the random horizontal component. Reference site condition is firm rock, defined as having an average shear-wave velocity of 760 m/sec in the top 30 meters, corresponding to the boundary between NEHRP (National Earthquake Hazards Reduction Program) site classes B and C. Documentation, gridded values, interactive maps, and GIS data used to make the maps are available online at http://eqhazmaps.usgs.gov/ or http://pubs.usgs.gov/sim/2005/2883

ACKNOWLEDGMENTS

California part of the map produced jointly with the California Geological Survey.

REFERENCES

Frankel, A.D., Petersen, M.D., Mueller, C.S., Haller, K.M., Wheeler, R.L., Leyendecker, E.V., Wesson, R.L., Harmsen, S.C., Cramer, C.H., Perkins, D.M., and Rukstales, K.S., 2002, Documentation for the 2002 Update of the National Seismic-Hazard Maps: U.S. Geological Survey Open-File Report 02-420, 39 p.

Haller, K.M., Wheeler, R.L., and Rukstales, K.S., 2002, Documentation of changes in fault parameters for the 2002 National Seismic Hazard Maps -- Conterminous United States except California: U.S. Geological Survey Open-File Report 02-467, 34 p.

United States county base map data from http://nationalatlas.gov/
All other base map data from ESRI Inc. Digital Chart of the World

Albers Equal-Area Conic Projection
Standard Parallels 29.5°N and 45.5°N
Central Meridian 95°W

SCALE 1: 7,000,000

100 0 100 200 300 400 500 600 700 800 900 1000 KILOMETERS

100 0 100 200 300 400 500 600 700 800 900 1000 MILES

Manuscript approved for publication March 11, 2005

Digital data prepared with ArcGIS 8.3 running under Windows 2000 Server

Peak Horizontal Acceleration
With 10 Percent Probability of Exceedance in 50 Years

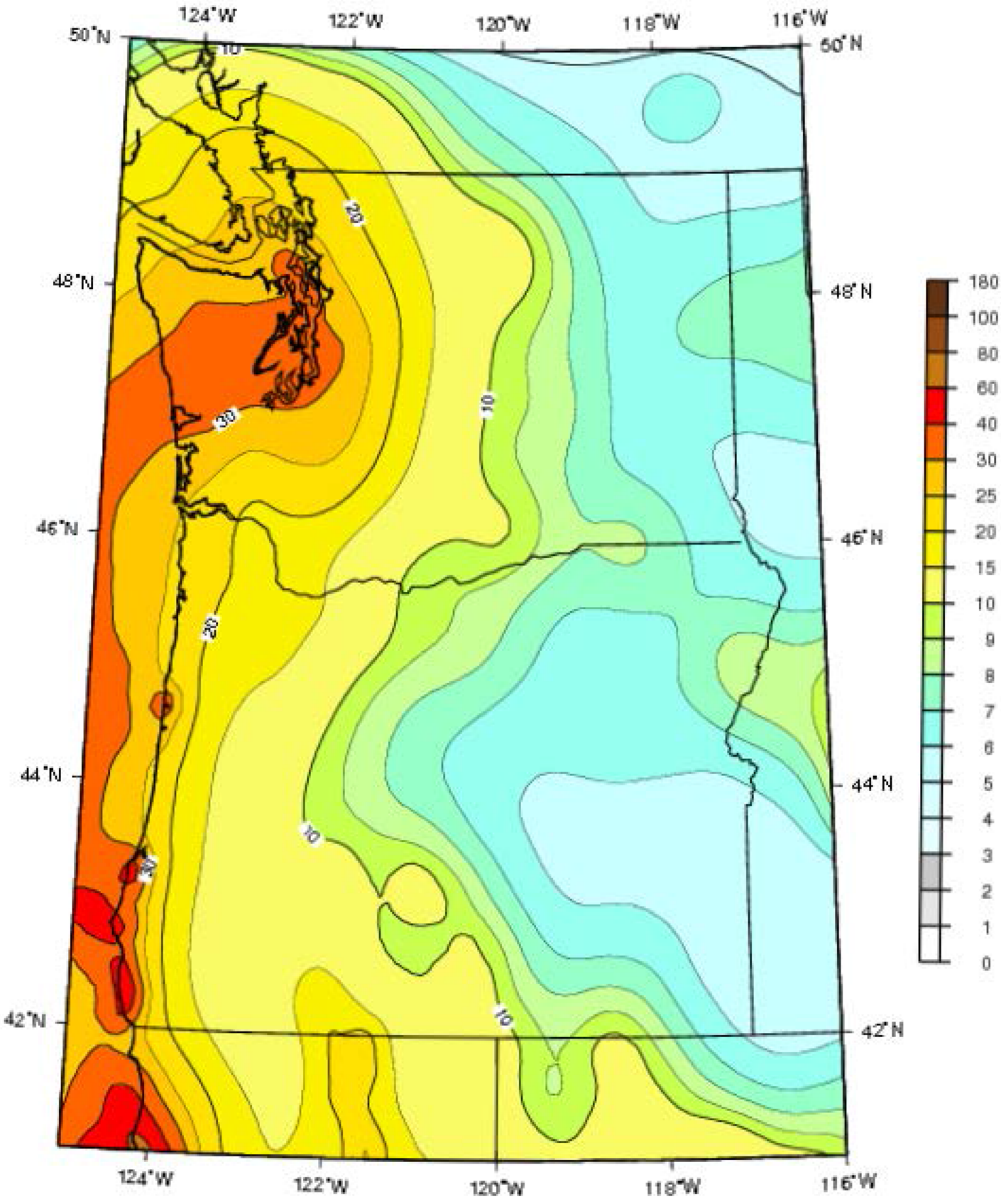
SEISMIC-HAZARD MAPS FOR THE CONTERMINOUS UNITED STATES

By

Arthur D. Frankel, Mark D. Petersen, Charles S. Mueller, Kathleen M. Haller, Russell L. Wheeler, E.V. Leyendecker, Robert L. Wesson, Stephen C. Harmsen, Chris H. Cramer, David M. Perkins, and Kenneth S. Rukstales

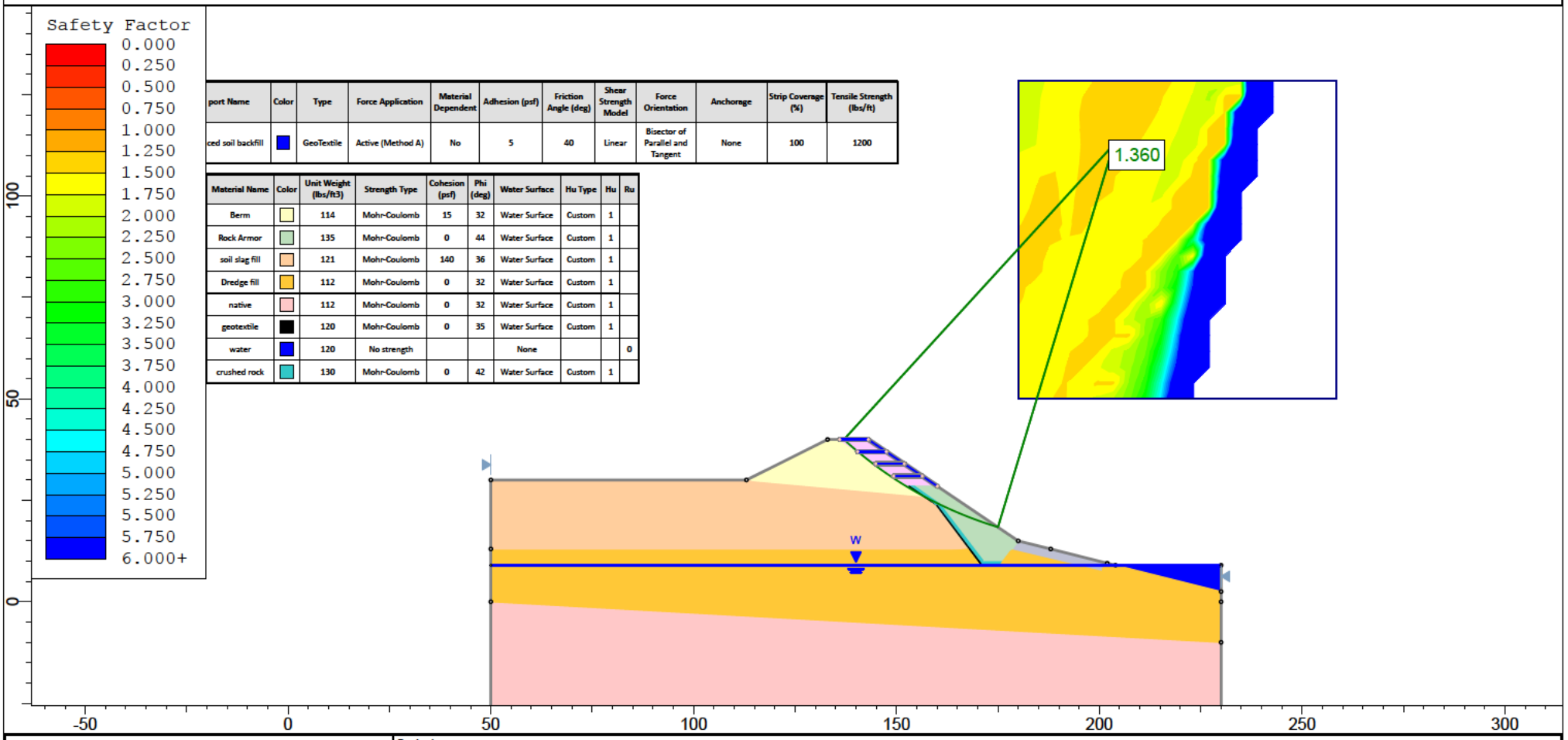
2005

Peak Accel. (%g) with 10% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002



ATTACHMENT D

STABILITY OUTPUT



port Name	Color	Type	Force Application	Material Dependent	Adhesion (psf)	Friction Angle (deg)	Shear Strength Model	Force Orientation	Anchorage	Strip Coverage (%)	Tensile Strength (lbs/ft)
ced soil backfill		GeoTextile	Active (Method A)	No	5	40	Linear	Bisector of Parallel and Tangent	None	100	1200

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Berm		114	Mohr-Coulomb	15	32	Water Surface	Custom	1	
Rock Armor		135	Mohr-Coulomb	0	44	Water Surface	Custom	1	
soil slag fill		121	Mohr-Coulomb	140	36	Water Surface	Custom	1	
Dredge fill		112	Mohr-Coulomb	0	32	Water Surface	Custom	1	
native		112	Mohr-Coulomb	0	32	Water Surface	Custom	1	
geotextile		120	Mohr-Coulomb	0	35	Water Surface	Custom	1	
water		120	No strength			None			0
crushed rock		130	Mohr-Coulomb	0	42	Water Surface	Custom	1	

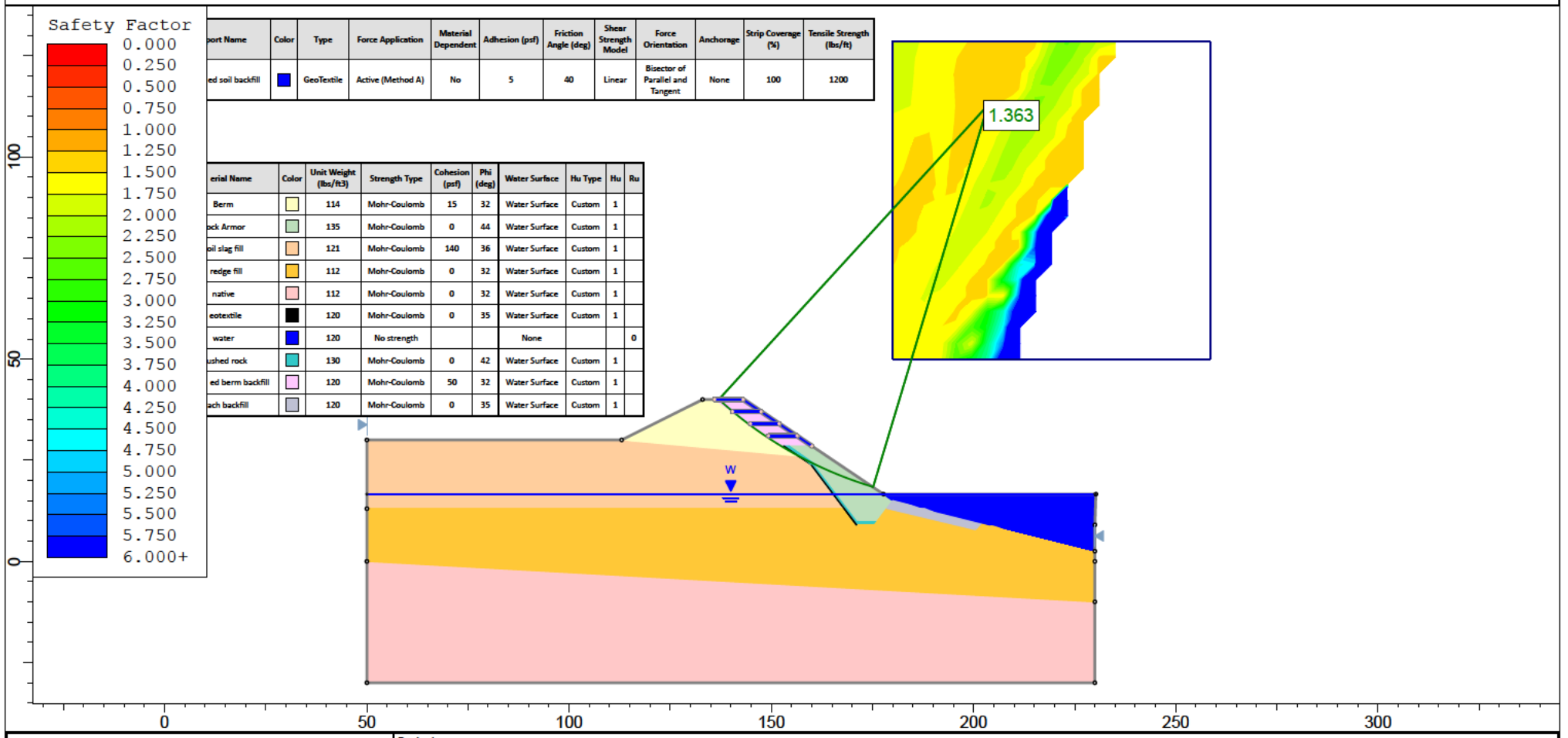
rocscience

SLIDEINTERPRET 6.031

Project	Evraz Riverbank Stabilization Project		
Analysis Description			
Drawn By	MB	*Scale* 1:440	*Company* CRETE Consulting Inc
Date	10/28/2014		*File Name* RB mid project.slim

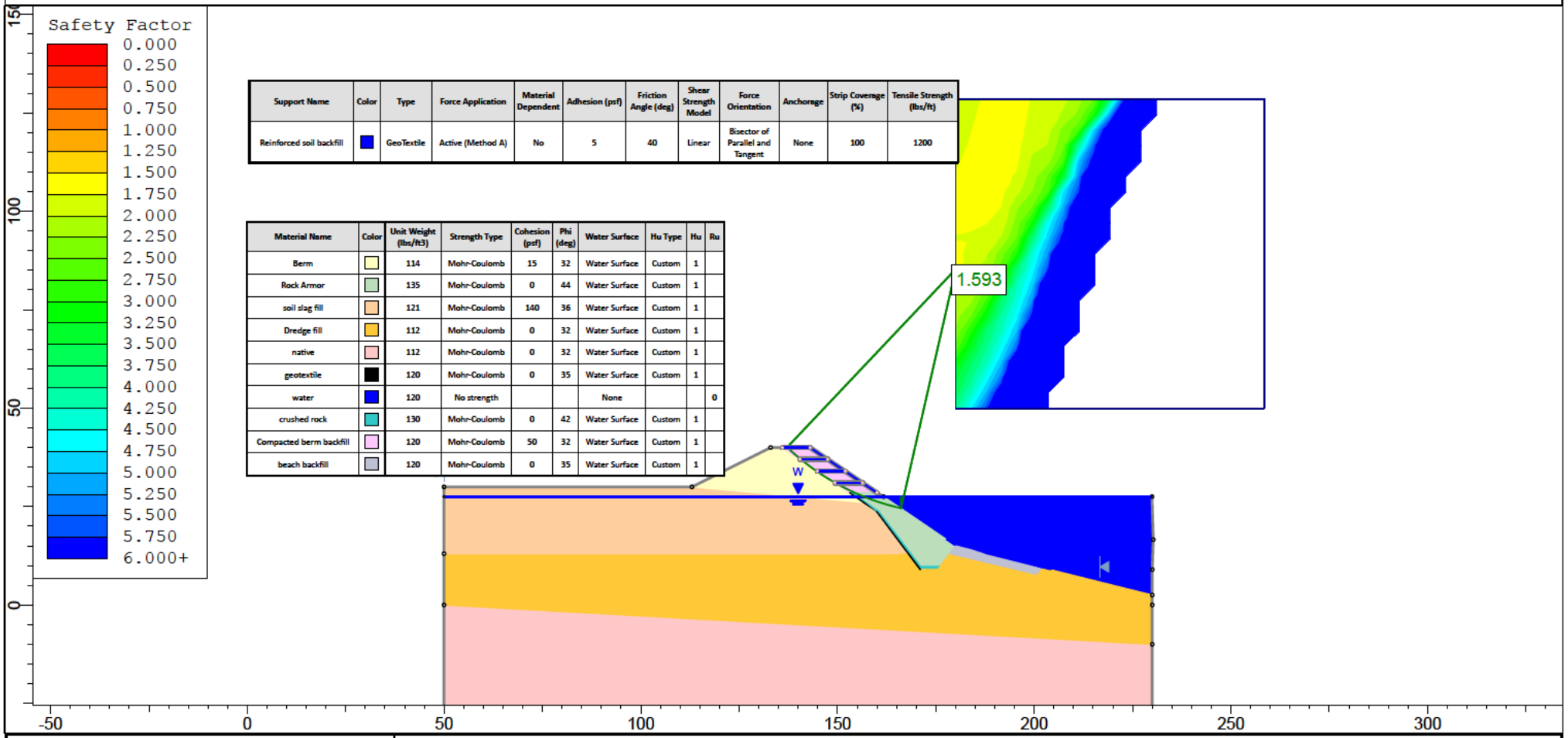
port Name	Color	Type	Force Application	Material Dependent	Adhesion (psf)	Friction Angle (deg)	Shear Strength Model	Force Orientation	Anchorage	Strip Coverage (%)	Tensile Strength (lbs/ft)
ed soil backfill		GeoTextile	Active (Method A)	No	5	40	Linear	Bisector of Parallel and Tangent	None	100	1200

erial Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Berm		114	Mohr-Coulomb	15	32	Water Surface	Custom	1	
ock Armor		135	Mohr-Coulomb	0	44	Water Surface	Custom	1	
oil slag fill		121	Mohr-Coulomb	140	36	Water Surface	Custom	1	
redge fill		112	Mohr-Coulomb	0	32	Water Surface	Custom	1	
native		112	Mohr-Coulomb	0	32	Water Surface	Custom	1	
eotextile		120	Mohr-Coulomb	0	35	Water Surface	Custom	1	
water		120	No strength			None			0
ushed rock		130	Mohr-Coulomb	0	42	Water Surface	Custom	1	
ed berm backfill		120	Mohr-Coulomb	50	32	Water Surface	Custom	1	
ach backfill		120	Mohr-Coulomb	0	35	Water Surface	Custom	1	



SLIDEINTERPRET 6.031

Project	Evraz Riverbank Stabilization Project		
Analysis Description			
Drawn By	MB	*Scale* 1:440	*Company* CRETE Consulting Inc
Date	10/28/2014	*File Name*	RB mid project ohwm water level.slim



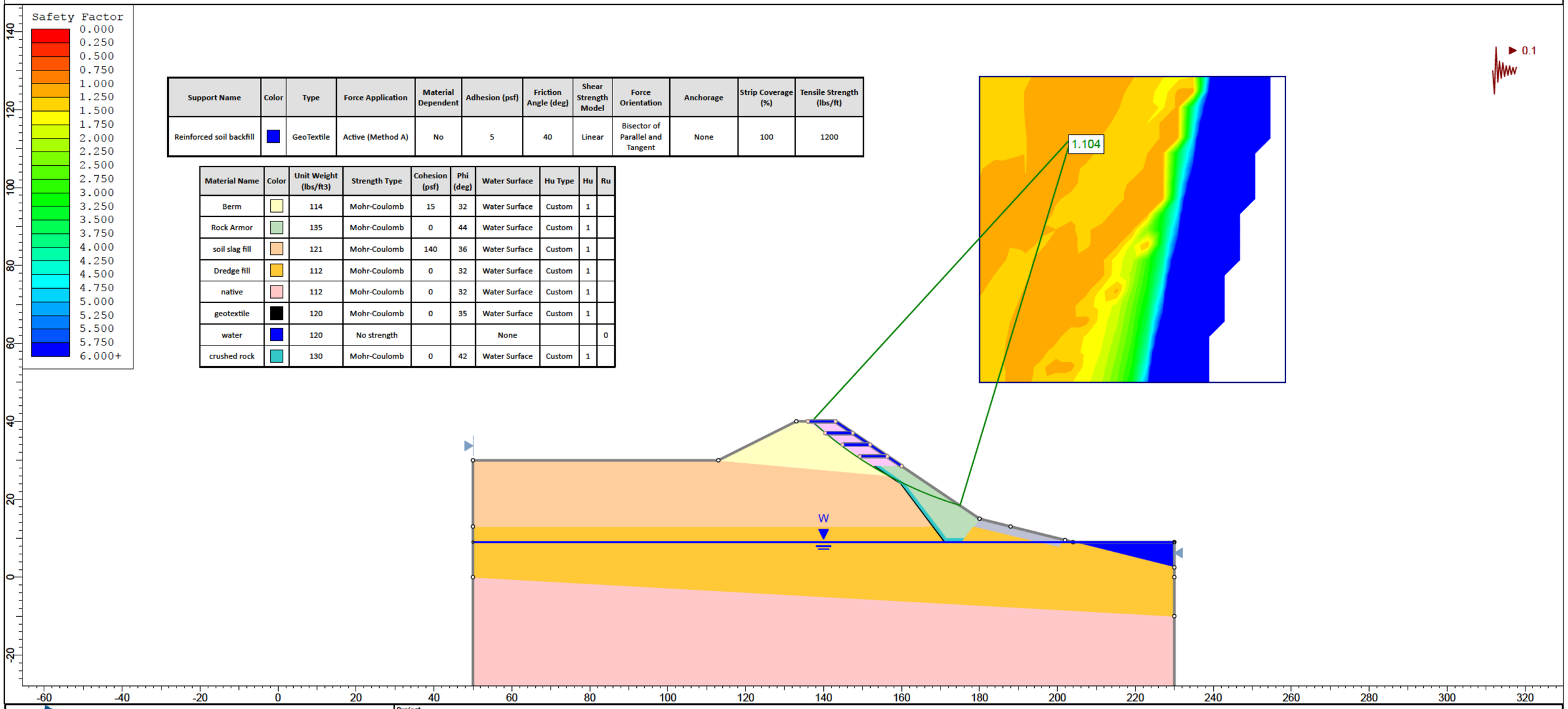
Support Name	Color	Type	Force Application	Material Dependent	Adhesion (psf)	Friction Angle (deg)	Shear Strength Model	Force Orientation	Anchorage	Strip Coverage (%)	Tensile Strength (lbs/ft)
Reinforced soil backfill		GeoTextile	Active (Method A)	No	5	40	Linear	Bisector of Parallel and Tangent	None	100	1200

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Berm		114	Mohr-Coulomb	15	32	Water Surface	Custom	1	
Rock Armor		135	Mohr-Coulomb	0	44	Water Surface	Custom	1	
soil slag fill		121	Mohr-Coulomb	140	36	Water Surface	Custom	1	
Dredge fill		112	Mohr-Coulomb	0	32	Water Surface	Custom	1	
native		112	Mohr-Coulomb	0	32	Water Surface	Custom	1	
geotextile		120	Mohr-Coulomb	0	35	Water Surface	Custom	1	
water		120	No strength			None			0
crushed rock		130	Mohr-Coulomb	0	42	Water Surface	Custom	1	
Compacted berm backfill		120	Mohr-Coulomb	50	32	Water Surface	Custom	1	
beach backfill		120	Mohr-Coulomb	0	35	Water Surface	Custom	1	

rocscience

SLIDEINTERPRET 6.031

Project	Evraz Riverbank Stabilization Project		
Analysis Description			
Drawn By	MB	*Scale* 1:453	*Company* CRETE Consulting Inc
Date	10/28/2014		*File Name* RB mid project high water level.slim

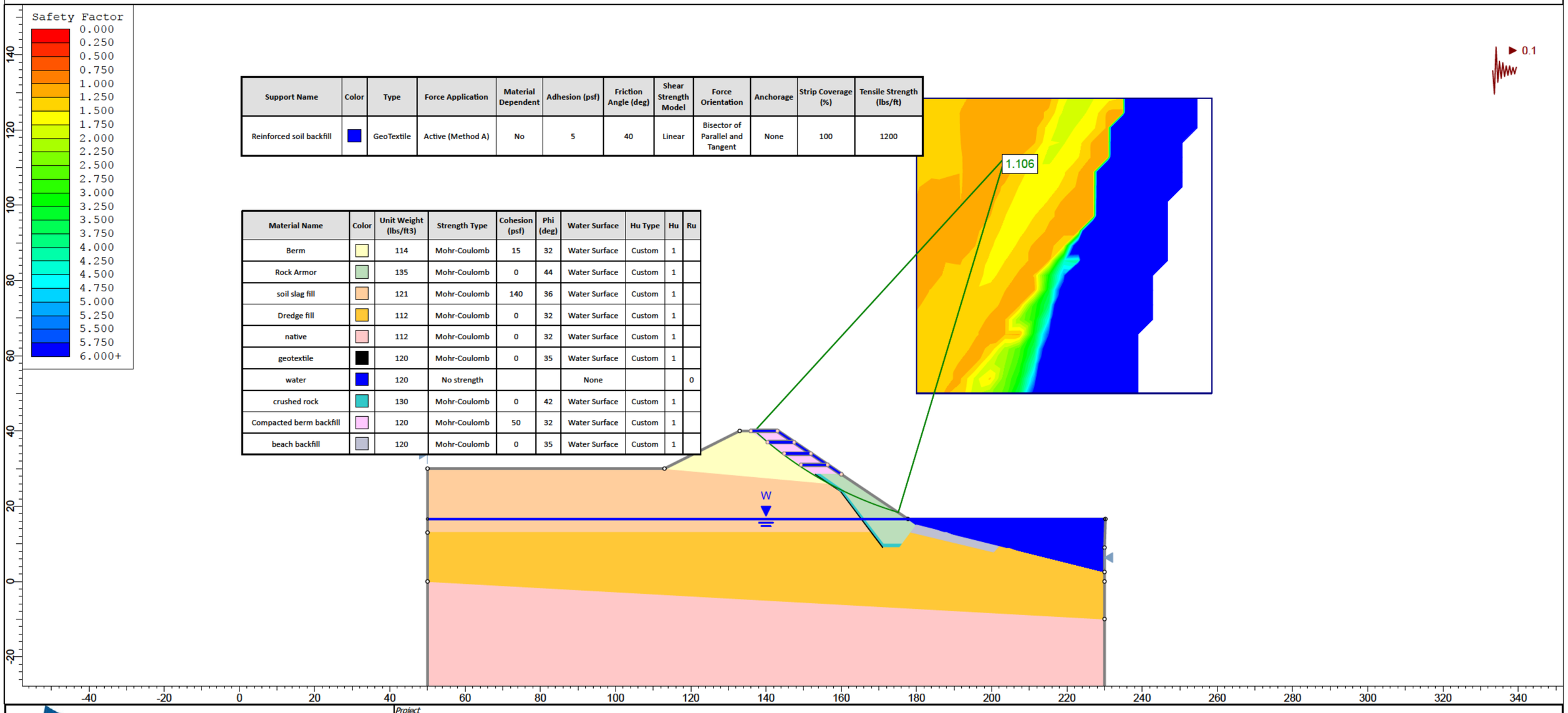


Support Name	Color	Type	Force Application	Material Dependent	Adhesion (psf)	Friction Angle (deg)	Shear Strength Model	Force Orientation	Anchorage	Strip Coverage (%)	Tensile Strength (lbs/ft)
Reinforced soil backfill		GeoTextile	Active (Method A)	No	5	40	Linear	Bisector of Parallel and Tangent	None	100	1200

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Berm		114	Mohr-Coulomb	15	32	Water Surface	Custom	1	
Rock Armor		135	Mohr-Coulomb	0	44	Water Surface	Custom	1	
soil slag fill		121	Mohr-Coulomb	140	36	Water Surface	Custom	1	
Dredge fill		112	Mohr-Coulomb	0	32	Water Surface	Custom	1	
native		112	Mohr-Coulomb	0	32	Water Surface	Custom	1	
geotextile		120	Mohr-Coulomb	0	35	Water Surface	Custom	1	
water		120	No strength			None			0
crushed rock		130	Mohr-Coulomb	0	42	Water Surface	Custom	1	

SLIDEINTERPRET 6.031

Project	Evraz Riverbank Stabilization Project		
Analysis Description			
Drawn By	MB	Scale	1:291
Company	CRETE Consulting Inc		
Date	11/3/2014	File Name	RB mid project.slim



Support Name	Color	Type	Force Application	Material Dependent	Adhesion (psf)	Friction Angle (deg)	Shear Strength Model	Force Orientation	Anchorage	Strip Coverage (%)	Tensile Strength (lbs/ft)
Reinforced soil backfill		GeoTextile	Active (Method A)	No	5	40	Linear	Bisector of Parallel and Tangent	None	100	1200

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Berm		114	Mohr-Coulomb	15	32	Water Surface	Custom	1	
Rock Armor		135	Mohr-Coulomb	0	44	Water Surface	Custom	1	
soil slag fill		121	Mohr-Coulomb	140	36	Water Surface	Custom	1	
Dredge fill		112	Mohr-Coulomb	0	32	Water Surface	Custom	1	
native		112	Mohr-Coulomb	0	32	Water Surface	Custom	1	
geotextile		120	Mohr-Coulomb	0	35	Water Surface	Custom	1	
water		120	No strength			None			0
crushed rock		130	Mohr-Coulomb	0	42	Water Surface	Custom	1	
Compacted berm backfill		120	Mohr-Coulomb	50	32	Water Surface	Custom	1	
beach backfill		120	Mohr-Coulomb	0	35	Water Surface	Custom	1	

SLIDEINTERPRET 6.031

Project	Evraz Riverbank Stabilization Project		
Analysis Description			
Drawn By	MB	Scale	1:302
Company	CRETE Consulting Inc		
Date	11/3/2014	File Name	RB mid project ohwm water level.slim

Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+

Support Name	Color	Type	Force Application	Material Dependent	Adhesion (psf)	Friction Angle (deg)	Shear Strength Model	Force Orientation	Anchorage	Strip Coverage (%)	Tensile Strength (lbs/ft)
Reinforced soil backfill		GeoTextile	Active (Method A)	No	5	40	Linear	Bisector of Parallel and Tangent	None	100	1200

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Berm		114	Mohr-Coulomb	15	32	Water Surface	Custom	1	
Rock Armor		135	Mohr-Coulomb	0	44	Water Surface	Custom	1	
soil slag fill		121	Mohr-Coulomb	140	36	Water Surface	Custom	1	
Dredge fill		112	Mohr-Coulomb	0	32	Water Surface	Custom	1	
native		112	Mohr-Coulomb	0	32	Water Surface	Custom	1	
geotextile		120	Mohr-Coulomb	0	35	Water Surface	Custom	1	
water		120	No strength			None			0
crushed rock		130	Mohr-Coulomb	0	42	Water Surface	Custom	1	
Compacted berm backfill		120	Mohr-Coulomb	50	32	Water Surface	Custom	1	
beach backfill		120	Mohr-Coulomb	0	35	Water Surface	Custom	1	

1.276

▶ 0.1

W

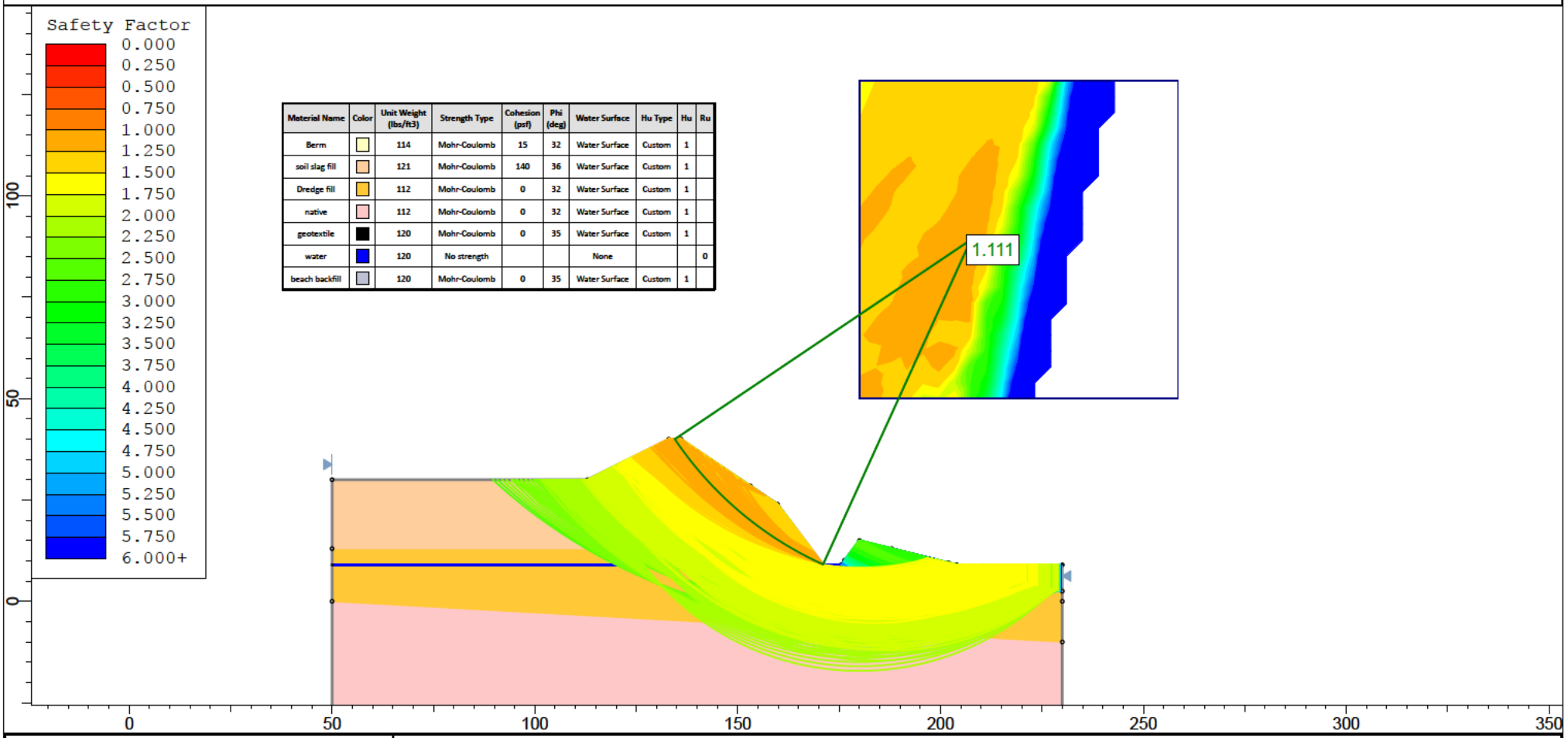
-40 -20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340

-20 0 20 40 60 80 100 120 140

rocscience

SLIDEINTERPRET 6.031

Project	Evraz Riverbank Stabilization Project		
Analysis Description			
Drawn By	MB	Scale	1:300
Company	CRETE Consulting Inc		
Date	11/3/2014	File Name	RB mid project high water level.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Berm		114	Mohr-Coulomb	15	32	Water Surface	Custom	1	
soil slag fill		121	Mohr-Coulomb	140	36	Water Surface	Custom	1	
Dredge fill		112	Mohr-Coulomb	0	32	Water Surface	Custom	1	
native		112	Mohr-Coulomb	0	32	Water Surface	Custom	1	
geotextile		120	Mohr-Coulomb	0	35	Water Surface	Custom	1	
water		120	No strength			None			0
beach backfill		120	Mohr-Coulomb	0	35	Water Surface	Custom	1	

SLIDEINTERPRET 6.031

Project	Evraz Riverbank Stabilization Project		
Analysis Description			
Drawn By	MB	*Scale* 1:440	*Company* CRETE Consulting Inc
Date	10/28/2014		*File Name* RB mid project during construction.slim

Attachment 3 – Berm Stabilization Calculation

PURPOSE: To determine the erosion protection / stability requirements for the rebuilt berm on the riverbank project.

REFRENCE: Drawings - 50% design set for riverbank project. Attachment A.

GIVEN:

A) The excavation slope of the riverbank is 1.5H:1V. The rebuilt slope is the same - 1.5H:1V.

B) Height of rebuilt berm ranges from 6.5' to 10'.

C) Horizontal distance to be rebuilt is ≈ 7.2 feet

DISCUSSION:

The rebuilt riverbank slope will be 1.5H:1V and compacted in place over the rebuilt rock armor protection. This slope may require some internal stabilization and it will need surface protection to resist erosion and promote plant growth.

BY MGB DATE 9/29/2014 Sheet No 1 of 5

PROJECT EVRAZ Riverbank PROJECT NUMBER _____

CRETE CONSULTING, INC.

Material Properties

Berm material -

Borings that show the characteristics of the berm material include the following:

Boring	Sta	Blowct	Description
MW-7	19+10	3/2/3 2/3/5 2/2/4 3/1/2	Fine Sand - Dk yellow brown, trc f-gravel, trc silt. moist
MW-9	14+50	3/5/7 3/2/3 2/2/2 1/2/2	silty f- sand, trc gravel, moist
MW-13	10+75	50/6" 50/6"	f sand and Silt, some f-gravel, moist discount these N values

⇒ use silty f- sand, trc m-c sand, trc fi-gravel, moist

$$SPT\ \bar{N} = \frac{5+8+6+3+12+5+4+4}{8} = 5.8$$

using figures 19.4 ÷ 19.6 of Ref 1, and figure 7 of ref. 2. (from Stability calculation)

use. $\phi = 32°$ $C = 20$ psf. (primarily a granular mtl)

$\gamma_d = 104$ pcf. $w_c = 10\%$

$\gamma_n = 114$ pcf

MGB 9/29/2014 Sheet 2 of —

Analyses

A) Internal Stability of berm backfill.

In order to keep the overall riverbank stable, the berm backfill will need to be stable enough so that the failure surface does not penetrate through the backfill. This requires that the internal berm backfill strength needs to be augmented by including horizontal layers of geotextile fabric/grid to result in an increase in internal strength of the backfill when compared to backfill without the geotextile fabric/grid.

Utilize SLIDE6.0 to perform the analyses. The program has the ability to model geotextile/geogrid reinforcement placed in the material in horizontal layers at varying spacings.

In order to maintain the failure surface* out of the berm backfill, require a geotextile with the following properties:

Tensile Strength wide width 100 lbs/inch @ 5% strain
pullout adhesion 5psf.
Layer spacing 2.5 ft.

* See Stability analysis calculations for specifics.

BY MGB DATE 9/29/2014 Sheet No 3 of 5

PROJECT EVRA2 Riverbank PROJECT NUMBER

CRETE CONSULTING, INC.

Materials that will provide the needed stabilization are:-

US 2600 — US Fabrics — Attachment A

Strata Grid — SG150 — Attachment B

The first section of geotextile should be placed over the top of the rock armor to keep ~~bar~~ berm backfill from entering into the rock

GeoTextile layers shall be placed horizontal with 1' min overlap between layers, or spliced according to manufacturers recommendation

Backfill shall be placed in 8" max lift thickness & compacted to 90% ASTM D-1557 max compaction.

Geotextile layers shall be placed every 2.5' within the backfill in horizontal layers.

Geotextile shall be laid out on a smooth sagtem and stretched so that no wrinkles exist in the ~~fabric~~ material

Backfill shall be placed in a controlled manner so that equipment is never closer than 6" to the geotextile layer.

B) Surface erosion protection:

Requirement

1. Needs to be designed for a slope that is 1.5H:1V
2. Needs to be biodegradable after a number of years to allow vegetation to become established.
3. Needs to withstand some current in the event of high water prior to vegetation establishment.

BY MB. DATE 10-13-2014 Sheet No 4 of 5

PROJECT Evraz RB - Berm soil Stability PROJECT NUMBER _____

CRETE CONSULTING, INC.

Material -

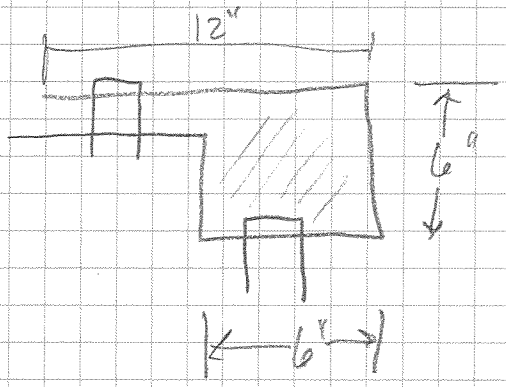
Contact Floyd Stretch @ ACM in Portland.

He recommends their product

C125 BN - Details attached - Attachment C

Attachment B indicates that C125 BN is designed for high flow channels 1H:1V & steeper for water velocities 10 ft/sec and less.

Attachment C provides installation guidelines with a staple pattern of 2.5 staples per sq. yd on the 1.5 H:1V slope. The fabric needs a shallow anchor trench at the top of the slope that is shown on page 4 of attachment C.



Discussions about approximate material costs -

$1.50/sq for C125 BN

1 box of staples - 1000/box = $45 2.5/sq.

For 16,000 sf of area, ≈ 6000 staples ⇒ $270 staples

$\frac{16,000}{9} \times 1.25 \times \$1.50/sq = \$3,400$

say $4000 mtls

plus labor -

BY MB DATE 10.13.2014 Sheet No 5 of 5

PROJECT EVRAZ RB - Erosion control / Boom stability PROJECT NUMBER

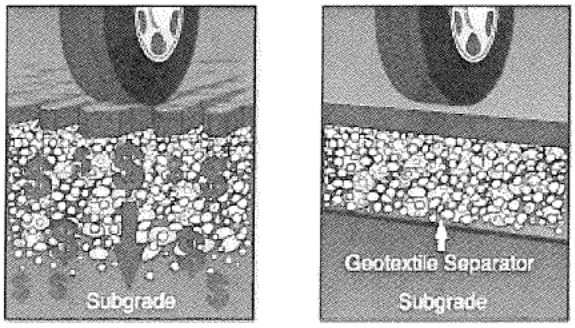
CRETE CONSULTING, INC.

Attachment A

US 2600

Woven Geotextile

US 2600 is a woven geotextile made of 100% high-tenacity polypropylene yarns. US 2600 resists ultraviolet and biological deterioration, rotting, naturally encountered basics and acids. Polypropylene is stable within a pH range of 2 to 13. US 2600 meets the following M.A.R.V. values except where noted:



PROPERTY	TEST METHOD	ENGLISH	METRIC
Wide Width Tensile	ASTM D-4595	2,640 x 2,460 lbs/ft (220 x 205 lbs/in)	38.5 x 35.9 kN/m
Tensile Strength @ 2% Strain	ASTM D-4595	480 x 588 lbs/ft (40 x 49 lbs/in)	7.0 x 8.6 kN/m
Wide Width Tensile @ 5% Strain	ASTM D-4595	1,212 x 1,356 lbs/ft (101 x 113 lbs/in)	17.7 x 19.8 kN/m
Wide Width Tensile @ 10% Strain	ASTM D-4595	2,340 x 2,412 lbs/ft (195 x 201 lbs/in)	34.1 x 35.2 kN/m
Apparent Opening Size	ASTM D-4751	30 US Sieve	0.600 mm
Permittivity	ASTM D-4491	0.70 Sec-1	0.70 Sec-1
Permeability	ASTM D-4491	0.04 Sec-1	0.04 Sec-1
Water Flow Rate	ASTM D-4491	50 g/min/sf	2,037 l/min/sm
UV Resistance @ 500 Hours	ASTM D-4355	80%	80%

ROLL SIZE	ROLL DIAMETER	AREA	WEIGHT
15' x 300'	11.0 in	500 sys	240 lbs

Attachment B

SG 150

Bi-Axial Knitted Geogrid

STRATAGRID geogrids are constructed of high molecular weight and high tenacity polyester yarns utilizing a complex knitting process and polymer coating to provide superior engineering properties. STRATAGRID is engineered to be mechanically and chemically durable, in both the harsh construction installation phase and in aggressive soil environments (pH range from 3-9).

PROPERTY	TEST METHOD	ENGLISH	METRIC
Ultimate Strength	ASTM D-6637 Method A	1,875 lbs/ft	27.4 kN/m
Strength @ 2% Strain	ASTM D-6637 Method A	200 x 200 lbs/ft	2.9 x 2.9 kN/m
Strength @ 5% Strain	ASTM D-6637 Method A	400 x 300 lbs/ft	5.6 x 4.4 kN/m
Creep Limited Strength	ASTM D-5262/D-6992	1,136 lbs/ft	16.6 kN/m
LTDS (SW, SP, SM, SC)	LTDS or Tal	861 lbs/ft	12.56 kN/m
LTDS (GP, GW, GM, GC, SW, SP, SM, SC)	LTDS or Tal	795 lbs/ft	11.6 kN/m
LTDS (GW, GP, GM, GC)	LTDS or Tal	608 lbs/ft	8.9 kN/m
Molecular Weight (min.)	GRI GG8	-	25,000 g/mol
Carboxyl End Group Count (max.)	GRI GG7	-	30 Meg/kg
Aperture Size	Measured	.95 x .90 in	24.1 x 22.9 mm

ROLL SIZE	ROLL DIAMETER	AREA	WEIGHT
6' x 150'	9.0 in	100 sys	42 lbs
12' x 150'	11.0 in	200 sys	90 lbs

REDUCTION FACTOR	VALUE
RF(id) Soil - 20mm minus, D50 ≤ 0.2mm (SW, SP, SM, SC)	1.20
RF(id) Soil - 25mm minus, D50 ≤ 8mm (GP, GW, GM, GC, SW, SP, SM, SC)	1.30
RF(id) Soil - 50mm minus, D50 ≤ 20mm (GW, GP, GM, GC)	1.70
RF(d) (3 ≤ pH ≤ 9) (PET - CEG < 30, MW > 25,000)	1.10

SOIL INTERACTION COEFFICIENT	VALUE
Silts/Clay (ML, CL)	0.6 - 0.7
Sandy Silts & Clay (SC,GC)	0.7 - 0.8
Poorly-Graded Sand & Gravel, Silty Sand (GP, GM, SP, SM)	0.8 - 0.9
Well-Graded Gravel, Sand Gravel Mix, Well-Graded Sand (SW, GW)	0.9 - 1.0

US Fabrics, Inc. | 3904 Virginia Avenue | Cincinnati, OH 45227 (USA) | Phone: 800-518-2290 | Fax: (513) 271-4420

Attachment C

ROLLMAX™
ROLLED EROSION CONTROL

ROLLMAX™
ROLLED EROSION CONTROL

INSTALLATION GUIDE

Tensar®

(b) (4)

(b) (4)

(b) (4)

(b) (4)

(b) (4)

(b) (4)

Tensar. | NORTH AMERICAN GREEN®

Tensar International Corporation
2500 Northwinds Parkway, Suite 500
Alpharetta, Georgia 30009
800-TENSAR-1
tensarcorp.com

Distributed by:

EC_RMX_IC_1.13

ROLLMAX™
ROLLED EROSION CONTROL

Specification Sheet – BioNet® C125BN™ Erosion Control Blanket

(b) (4)

Tensar
NORTH AMERICAN GREEN®

Tensar International Corporation
2500 Northwinds Parkway
Suite 500
Alpharetta, GA 30009
800-TENSAR-1
tensarcorp.com

APPENDIX C

AS-BUILT DRAWINGS

EOSM STORE ST'K.	VENDOR NUMBER	BILL OF MATERIAL				DRWG. NO. D-86456	
NUMBER	NAME / NUMBER	PART NO.	PC. NO.	NO. REQ'D.	DESCRIPTION	COMMENTS	WEIGHT

AS-BUILT DRAWINGS
RIVERBANK SOURCE CONTROL MEASURE
EVRAZ PORTLAND RIVERGATE FACILITY
PORTLAND, OREGON

(b) (4)

PREPARED BY:

CRETE CONSULTING, INC.
108 S. WASHINGTON ST.
SUITE 300
SEATTLE, WA 98104

integral consulting inc.
319 SW WASHINGTON ST.
SUITE 1150
PORTLAND, OR 97204

AS-BUILT DRAWINGS

REGISTERED PROFESSIONAL ENGINEER
64468PE
OREGON
SEPT 25, 2009
MICHAEL GIRARD BYERS
5-27-2016
EXPIRATION DATE: 12/31/17

NO.	DATE	REVISION	BY	APPR.

CAD FILE LOCATION:
P:\Projects\C1144_StRives_Evraz\CAD\Production Drawings\Riverbank_Design\Final_AS_BUILTS\D86456_Cover_Sheet_Index.dwg

EVRAZ
14400 N.E. RIVERGATE BLVD.
PORTLAND, OREGON 97203
PH. (503) 240-5240

EVRAZ PORTLAND, OREGON

SCALE
DATE 5/27/2016
DRWN. EB
CHKD.-APPR. JS/MB

COVER SHEET AND INDEX TO SHEETS

CODE 110-520
DRWG. NO. D-86456
REV. 0

DO NOT SCALE DRAWING

TOLERANCES (UNLESS OTHERWISE SPECIFIED)

FRACTIONAL DIM.	± 1/16
DECIMAL 1 PLACE DIM.	± .100
DECIMAL 2 PLACE DIM.	± .015
DECIMAL 3 PLACE DIM.	± .005
ANGLES	± 0°-30'

FINISH SYMBOLS
- P/L POLISH
- G/G GRIND
- F/G FINE
- ORD ORDINARY
- R/G ROUGH
- MO MACHINE CUT

EOSM STORE ST'K.	VENDOR NUMBER	BILL OF MATERIAL	DRWG. NO. D-86457

(b) (4)

AS-BUILT DRAWINGS

REGISTERED PROFESSIONAL ENGINEER
64468PE
OREGON
SEPT 25, 2009
MICHAEL GIRARD BYERS
5-27-2016
EXPIRATION DATE: 12/31/17

PREPARED BY:

CRETE CONSULTING, INC.
108 S. WASHINGTON ST.
SUITE 300
SEATTLE, WA 98104

integral consulting inc.
319 SW WASHINGTON ST.
SUITE 1150
PORTLAND, OR 97204

FINISH SYMBOLS:
- POLISH
- GRIND
- FINE
- ORDINARY
- ROUGH
- MACHINE CUT

DO NOT SCALE DRAWING

TOLERANCES
(UNLESS OTHERWISE SPECIFIED)

FRACTIONAL DIM.	± 1/16
DECIMAL 1 PLACE DIM.	± .100
DECIMAL 2 PLACE DIM.	± .015
DECIMAL 3 PLACE DIM.	± .005
ANGLES	± 0°-30'

EVRAZ
14400 N.E. RIVERGATE BLVD.
PORTLAND, OREGON 97203
PH. (503) 240-5240

EVRAZ
PORTLAND, OREGON

LEGEND AND GENERAL NOTES

SCALE	NTS
DATE	5/27/2016
DRWN.	EB
CHKD.-APPR.	JS/MB

CODE	DRWG. NO.	REV.
110-520	D-86457	0

(b) (4)

(b) (4)

(b) (4)

(b) (4)

(b) (4)

(b) (4)

(b) (4)

(b) (4)

(b) (4)